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ABSTRACT

The National Aeronautics and Space Administration's (NASA) Earth Science Enterprise (ESE) aims to understand Earth systems from every component including land surface, oceans, atmosphere, ice sheets, and biota from an interdisciplinary approach. This catalog provides information on ESE programs and resources for all educational audiences including students at all levels, teachers, and faculty. Contents include: (1) "Student Support"; (2) "Teacher and Faculty Preparation and Enhancement"; (3) "Support for Systemic Improvement"; (4) "Curriculum Support and Dissemination"; (5) "Educational Technology"; (6) "Informal Education"; and (7) "Professional/Workforce Development". (YDS)

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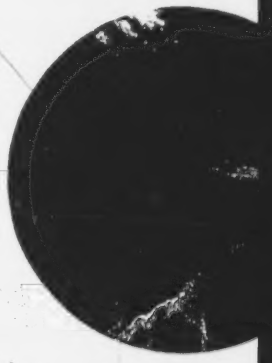
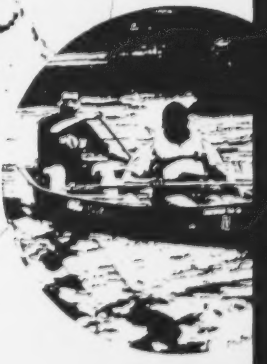
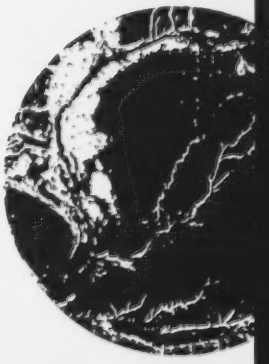
EARTH SCIENCE ENTERPRISE

2002 Education Catalog







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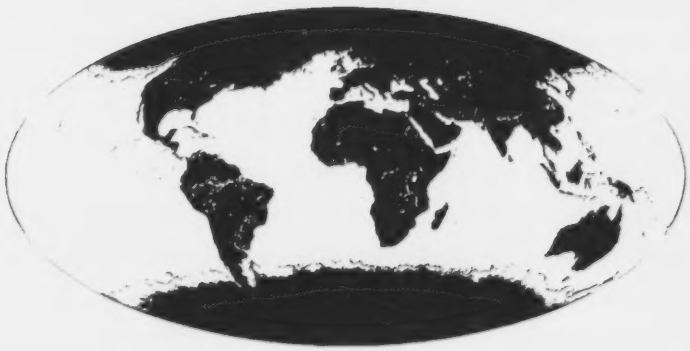


COVER IMAGE

MODIS Global Sea Surface Temperature, one-month composite for May 2001. Image produced by MODIS Ocean Group, NASA GSFC, and the University of Miami. See the acknowledgments on page 88 for a description of this image, as well as other cover images.

NASA Earth Science Enterprise: 2002 Education Catalog is available online at:
http://earth.nasa.gov/education

National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

Reply to Attn of: Y

February 1, 2002

Dear Colleague:

NASA's Earth Science Enterprise is very proud of its commitment to education. Our program is based on a new generation of Earth science -- one that studies the Earth's land, oceans, air, ice, and life as a complex, integrated system. As this *NASA Earth Science Enterprise: 2002 Education Catalog* shows, our effort to deliver NASA's unique Earth system science research and technology to all education audiences is robust and dynamic.

Our education effort reaches beyond science and technology interests by promoting knowledge and skills in geography, English language arts, and mathematics. We also respond to needs of the broad education audience by providing a diverse array of products and programs for formal classroom instruction, informal education, and professional and workforce development. Many of the programs are targeted at using technology while others have no technology requirements.

We invite you to join our Earth system science education effort and hope that this catalog will identify many avenues for your participation. In addition to this print version, we periodically update this content at our Web site, www.earth.nasa.gov/education. We trust that you will find this catalog useful in your quest to promote Earth system science education.

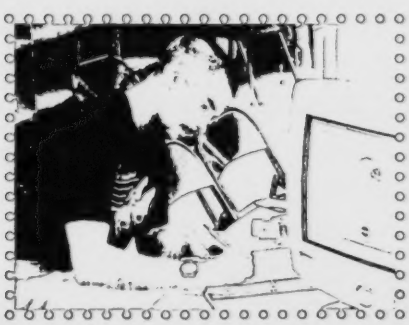
Cordially,

Ghassen R. Asrar
Associate Administrator for
Earth Science

George E. Reese
Assistant Administrator for
Equal Opportunity

Vicki A. Novak
Assistant Administrator for
Human Resources and Education

NASA
EARTH SCIENCE ENTERPRISE
2002 Education Catalog



Office of Earth Science
National Aeronautics and
Space Administration

Washington, DC
January 2002

CONTENTS

INTRODUCTION 1

FORMAL EDUCATION

STUDENT SUPPORT 2

Elementary & Secondary 2

- Access Earth
- Aeronautics and Earth Science Academy
- Ames Aerospace Encounter
- Challenger Center for Space Science Education
- Chesapeake Bay Watershed Initiative
- The Dynamic Earth
- Forest Watch
- The GLOBE Program
- ISS EarthKAM
- The JASON Project
- NASA Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)
- NASA Student Involvement Program (NSIP)
- Odyssey of the Mind
- PIPELINES
- Project SUN—Students Understanding Nature
- Students' Cloud Observations Online (S'COOL) Project
- Student's Online Atmospheric Research (SOLAR)
- Visiting Student Enrichment Program
- You Be the Scientist with Satellite Imagery in EZ/EC Communities

Undergraduate & Graduate 10

- Center for Hydrology, Soil Climatology, and Remote Sensing's Undergraduate Summer Enrichment Program
- Center for the Study of Terrestrial and Extraterrestrial Atmospheres (CSTEA)
- Curriculum Improvement Partnership Award Program (CIPA)
- Earth System Science Fellowship Program
- Goddard Space Flight Center/ Howard University Fellowship in Atmospheric Science (GoHFAS)
- Graduate Student Summer Program in Earth System Science
- NASA Academy
- NASA Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)
- NASA Graduate Student Researchers Program (GSRP)
- NASA Summer School for High Performance Computational Earth and Space Sciences
- NASA Undergraduate Student Research Program (USRP)
- National Space Grant College and Fellowship Program (NSGCFP)
- PACES Scholars
- Partnership Awards for the Integration of Research into Undergraduate Education (PAIR)
- PIPELINES
- Remote Sensing of Tribal Lands
- STEP Careers in Research Exploration Program
- Summer Institute on Atmospheric and Hydrospheric Sciences
- Undergraduate Student Awards for Research (USAR)
- Visiting Student Enrichment Program

Postdoctorate 18

- National Research Council (NRC) Resident Research Associateship (RRA) Programs

TEACHER/FACULTY PREPARATION & ENHANCEMENT 19

Elementary & Secondary 19

- Access Earth
- Alaska Alliance for Earth System Science Education
- Certificate and Master's Degree Program in Earth/Space Science for Elementary/Secondary Teachers
- The Dynamic Earth
- Earth Science Component for Academic Professional Enhancement (ESCAPE)
- Earth Science Enterprise Research Program—University of Montana
- Earth System Science Academy
- Earth System Science Education Alliance (ESSEA)
- Earth System Science Online Professional Development Course—Elementary Teachers
- Earth System Science Online Professional Development Course—Middle School Teachers

Earth System Science Online Professional Development Course—High School Teachers
Earth System Science Online Course: An Opportunity in Geography Education
The Gaia Crossroads Project
Interactions and Diversity: Earth System Science and Beyond
An Interdisciplinary Professional Development Program for Teachers on Earth System Science Using Information Technology
ISS EarthKAM
NASA Goddard Institute for Space Studies—Institute on Climate and Planets
PIPELINES
Students' Cloud Observations Online (S'COOL) Project
The Tropical Center for Earth and Space Studies (TCESS)
University of Montana's Earth Observing System (EOS) Education Project

Postsecondary 28
Chautauqua Short Course—How We Study the Earth and Oceans from Space
NASA Faculty Fellowship Program
NASA Goddard Institute for Space Studies—Institute on Climate and Planets
NOVA
PIPELINES

CURRICULUM SUPPORT & DISSEMINATION 31

Elementary & Secondary 31
Access Earth
The Dynamic Earth
Earth System Science Education Alliance (ESSEA)
Earth System Science Online Professional Development Course—Elementary Teachers
Earth System Science Online Professional Development Course—Middle School Teachers
Earth System Science Online Professional Development Course—High School Teachers
Earth Systems Connections: An Integrated K–5 Science, Mathematics, and Technology Curriculum
Enhancement of the Global Systems Science High School Curriculum for the Digital Earth Initiative
Environmental Education Initiative—Field Museum of Chicago
Event Based Science (EBS) Remote Sensing Activities
Learning Technologies Project
Maryland Earth and Space Systems Science Curriculum Project
Mathematics of the Great Dismal Swamp Project
Minority University-SPace Interdisciplinary Network (MU-SPIN)
NASA Earth Science Missions—Education
NASA Goddard Institute for Space Studies—Institute on Climate and Planets
NASA Goddard Space Flight Center Earth System Science Education Program (GESSEP)
The Pigeon Adventure: An Adventure through Remote-Sensing History
Planet Earth Science—Earth System Science Education Courseware
Regional Earth Science Applications Centers (RESACs)
The Translingual Earth System Science Education Center
University of Montana's Earth Observing System (EOS) Education Project

Postsecondary 41
Curriculum Improvement Partnership Award Program (CIPA)
The Journal of Earth System Science Education (JESSE)
Minority University-SPace Interdisciplinary Network (MU-SPIN)
NOVA
Remote Sensing of Tribal Lands
University Based Program in Earth System Science Education (ESSE)

EDUCATIONAL TECHNOLOGY 44

Elementary & Secondary 44
Earth Science Component for Academic Professional Enhancement (ESCAPE)
Earth Science Enterprise Research Program—University of Montana
Earth System Science Education Alliance (ESSEA)
Earth System Science Online Professional Development Course—Elementary Teachers
Earth System Science Online Professional Development Course—Middle School Teachers
Earth System Science Online Professional Development Course—High School Teachers
Enhancement of the Global Systems Science High School Curriculum for the Digital Earth Initiative
The Gaia Crossroads Project
ISS EarthKAM
The JASON Project
Learning Technologies Project
Minority University-SPace Interdisciplinary Network (MU-SPIN)
Project SUN—Students Understanding Nature

Student's Online Atmospheric Research (SOLAR): A SAGE III Educational Outreach Program
University of Montana's Earth Observing System (EOS) Education Project

Postsecondary 50
The Journal of Earth System Science Education (JESSE)
Minority University-SPace Interdisciplinary Network (MU-SPIN)
Scenario Based Learning: Inquiry for a Digital Earth

SUPPORT FOR SYSTEMIC IMPROVEMENT 52

Elementary & Secondary 52
Alaska Alliance for Earth System Science Education
Maryland Earth and Space Systems Science Curriculum Project
NASA Earth Science Education Products Workshops
PIPELINES
Regional Earth Science Applications Centers (RESACs)
The Tropical Center for Earth and Space Studies (TCESS)

Undergraduate 54
NOVA
University Based Program in Earth System Science Education (ESSE)

INFORMAL EDUCATION 56
The Dynamic Earth
Earth & Sky Broadcast Fellowship
Earth Science Enterprise Museum Support
Electronic Theater Presentations
Environmental Education Initiative—Field Museum of Chicago
Eyes on Earth
Forces of Change
Global Links
Museums Teaching Planet Earth
NASA–National Park Service Partnership
Reach for the Stars: Girl Scouts of the USA, Science and NASA

WORKFORCE/ PROFESSIONAL DEVELOPMENT 61
NASA Workforce/Professional Development Program
Chesapeake Bay from Space
NASA Space Grant Extension Specialist in Geospatial Technology
Regional Earth Science Applications Centers (RESACs)

EARTH SCIENCE EDUCATION PRODUCTS & RESOURCES 63

FORMAL EDUCATION 63
Classroom Activities/ Curriculum Materials
Elementary 63
Middle School 65
High School 69
Postsecondary 73

INFORMAL EDUCATION 75

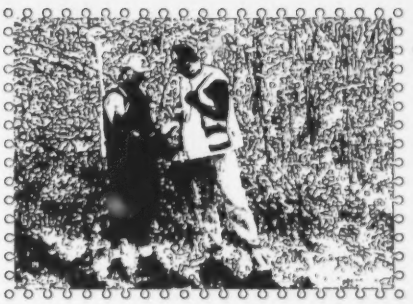
EDUCATIONAL RESOURCES 76
Bookmarks
Lithographs
Brochures
NASA Earth Science Enterprise Science Writing and Multimedia Team
NASA Earth Science Missions—Education
NASA Facts
Newsletter
Posters
Videotapes
Web Sites

NASA RESOURCES FOR EDUCATORS 82
Educator Resource Center Network (ERCN)
NASA Field Center Educator Resource Centers
NASA's Central Operation of Resources for Educators (CORE)
NASA's Education Home Page
NASA Spacelink
NASA Television (NTV)
National Space Grant College and Fellowship Program

INDEX 84

ACKNOWLEDGMENTS 88

Introduction



The purpose of **NASA's Earth Science Enterprise (ESE)** is to understand the total Earth system and the effects of natural and human-induced changes on the global environment. The Office of Earth Science is pioneering the new interdisciplinary field of research called Earth system science, born of the recognition that the Earth's land surface, oceans, atmosphere, ice sheets, and biota are both dynamic and highly interactive. Some of the Agency's most exciting science results and accomplishments have been in the area of Earth system science.

ESE has a strong national Earth system science education program developed in partnership with the NASA Headquarters Education Division and the Office of Equal Opportunity Programs. It is targeted at all education levels and audiences, with participants from across the U.S., and includes:

- ☐ ***Student Support,*** including hands-on education experiences, research opportunities, fellowships, brief courses, and summer workshops;
- ☐ ***Teacher and Faculty Preparation and Enhancement,*** including training workshops, courses, and research positions at NASA Centers;
- ☐ ***Support for Systemic Improvement,*** which aims to infuse Earth system science content into state and local curricula and education systems;
- ☐ ***Curriculum Support and Dissemination,*** including developing and distributing education products and curriculum materials that support national education standards;
- ☐ ***Educational Technology,*** using advanced technologies for education at all levels;
- ☐ ***Informal Education,*** providing opportunities outside formal school settings, where individuals of all ages, interests, and backgrounds can increase their appreciation and understanding of Earth system science; and
- ☐ ***Professional/Workforce Development,*** a growing area of ESE's education program, which will address requirements for identifying, developing, and enhancing the job skills and needs of an Earth system science, applications, and technology workforce.

Using content, imagery, and other information from its science program, ESE also produces a rich variety of education products for formal and informal education audiences. Internet sites, CD-ROMs, posters, curriculum materials, and videotapes bring NASA Earth system science to life in classrooms, museums and parks, community groups, and through print and broadcast media. Both educators and scientists are involved in developing ESE education products, from the initial concept design through testing and evaluation.

The NASA Earth Science Enterprise: 2002 Education Catalog provides information about Agency-wide Earth system science education programs and resources for all education audiences. An online version of this catalog, which is updated regularly, is available at:
http://www.earth.nasa.gov/education

Student support includes enrichment activities, such as brief courses, summer workshops, and hands-on science education experiences, which expose students to Earth system science subjects and processes. It also includes research opportunities through programs that provide direct financial assistance and fellowships, as well as research and training at NASA facilities and universities. These programs are providing opportunities for students at all education levels to develop new skills, gain experience working with researchers, and to learn first-hand about Earth system science careers and research.

ELEMENTARY & SECONDARY

○ Access Earth

http://accessearth.usm.maine.edu

Access Earth is a program for high school students with disabilities and teachers to encourage students with disabilities to enter careers in Earth system science. Students and teachers attend an intensive week-long summer institute focusing on land-ocean-atmosphere interactions, with field activities based at the Wells National Estuarine Research Reserve on the coast of Maine. Topics to be covered include climate change and sea level rise, land use changes, atmospheric pollution, and coastal watershed management. Participating teachers will work with scientists, educators, and students with disabilities to develop, test, and refine accessible Earth system science curriculum. Students will work with scientists, collecting and analyzing scientific data, and will learn about career opportunities in Earth system science.

In 2002 the institute will be offered from July 19 through July 26 for high school science teachers and from July 21 through July 26 for high school students with disabilities. The program is limited each year to 10 teachers and 15 students from Maine, New Hampshire, and Vermont. High school teachers of Earth science, general science, or environmental science are especially encouraged to apply, but applications will be accepted from other disciplines. Students should be entering ninth or tenth grade. Participating teachers are expected to further test and refine curriculum in their classrooms during the school year. Course materials and room and board are provided. Teacher participants receive a $500 stipend upon successful completion of the institute.

CONTACT: Nancy Lightbody, College of Education and Human Development, University of Southern Maine, 301C Bailey Hall, Gorham, ME 04038; *Phone:* 207-228-8115; *Fax:* 207-780-5224; *Email:* nancy@lightbody.org

10

○ Aeronautics and Earth Science Academy

The mission of the Medgar Evers College (MEC) **Aeronautics and Earth Science Academy (AESA)** is to provide under-represented middle and high school students an enriched academic experience that involves various areas of NASA's strategic enterprises, including Earth Science, Space Science, and Aeronautics and Space Transportation Technology, and thus encouraging these students to pursue careers in science, mathematics, engineering, and technology (SMET). The goals are to: 1) strengthen students' mathematics, science, computer, and communication skills; 2) integrate research and related-activities into their academic experiences so that students will be encouraged to enroll in SMET college preparatory courses; 3) give students the confidence and desire to pursue SMET careers; 4) encourage parental involvement and support of students in learning SMET; and 5) increase the number of under-represented students in the SMET pipeline. These students receive a variety of SMET-based experiences, including the following classes or workshops: Air Pollution, Water Pollution, Learning and Exploring Science with the Internet, Career Exploration in Science and Technology, Global Warming, Introduction to the Internet, Weather Analysis, Earth Science, Basic Social Skills, and Writing Skills/Newsletter

Development. Parents are encouraged to join the Parent Café and participate in science and technology conferences held at MEC.

The AESA program is held after school during the academic school year during a six-week period on Saturdays, from 9:00 am to 12:30 pm. During the summer, the program is in session Monday through Thursday from 10:00 am until 1:30 pm.

CONTACTS: Leon Johnson, Department of Physical, Environmental and Computer Science, Medgar Evers College of the City University of New York; *Email:* lpjohnson@mec.cuny.edu—or William Harris, AEL Project Director; *Email:* wharris@mec.cuny.org

Ames Aerospace Encounter

http://encounter.arc.nasa.gov

NASA Ames Research Center hosts fourth, fifth, and six grade classes in an interactive, hands-on program, entitled the **Ames Aerospace Encounter.** Located in a renovated supersonic wind tunnel, the Aerospace Encounter involves students in activities focused around four topics: aeronautics, space science, Space Station, and Mission Control/Earth science.

In the Mission Control/Earth science section, children work with a variety of scientific information collected by aircraft and spacecraft. The Earth system science tutorial features images of Earth taken from aircraft and satellites. The students find their way from space to Moffett Field, California by identifying specific geographic features in remotely-sensed images. In Aeronautics, students learn about the principles of flight and wind tunnels, and use computers to design airplanes. In the Space Sciences section, they experience some of the basics of physics in fun physical ways. Young people become astronauts on a simulated space station with different experiments to complete.

The Ames Aerospace Encounter is free; groups are accepted on a space-available basis for this popular program.

CONTACT: Ames Aerospace Encounter, Mail Stop 226-1, NASA Ames Research Center, Moffett Field, CA 94035-1000; *Phone:* 650-604-1110.

Challenger Center for Space Science Education

http://www.challenger.org

Challenger Center for Space Science Education is an international, not-for-profit education organization created in 1986 by the families of the astronauts tragically lost during the Challenger space shuttle mission. Using space exploration as a theme, Challenger Center's highly acclaimed programs inspire students to pursue math, science, and technology studies, while at the same time helping them develop critical life skills.

The organization launched the Challenger Learning Center Network in 1987. Learning Centers use technology-rich educational environments to create hands-on and minds-on learning experiences. They offer a variety of programs, from mission simulations for students to professional development workshops for instructors. Each year, more than 400,000 students visit Challenger Learning Center sites across the United States, Canada, and the United Kingdom.

There are four mission scenarios offered at Challenger Learning Centers. Encounter Earth, Voyage to Mars, Return to the Moon, and Rendezvous with a Comet allow students to rev up their imaginations and transform themselves into astronauts, scientists, and engineers. The scenarios meet or exceed National Science Education Standards, and were developed with NASA engineers and scientists to ensure an authentic experience.

Mission scenarios and fees vary by location. Log on to **www.challenger.org** for the Challenger Learning Center nearest you.

CONTACT: Challenger Center for Space Science Education, 1250 North Pitt Street, Alexandria, VA 22314; *Phone:* 703-683-9740; *Fax:* 703-683-7546.

Chesapeake Bay Watershed Initiative

http://destiny.mbhs.edu/cbwi

The Chesapeake Bay Watershed Initiative (CBWI) is a Mid-Atlantic Space Grant Consortia initiative involving K–12 students. Utilizing a hydrology-based scientific experiment, students determine if possible causes and effects of changes in nutrient levels in tributaries of the Bay can be correlated with weather phenomena and/or remotely-sensed changes in land cover or use.

Teams of students with varying levels of expertise measure, code, and electronically report in situ observations of water quality, compile weather information, and analyze Landsat satellite imagery to investigate nutrient changes in time and space. Code and observation forms are transportable nationwide.

CONTACT: Anne Anikis, Assistant Director, Maryland Space Grant Consortium, The Johns Hopkins University, Bloomberg Center for Physics and Astronomy, Room 203, 3400 N. Charles Street, Baltimore, MD 21218-2686; *Phone:* 410-516-7106; *Fax:* 410-516-4109; *Email:* anne@pha.jhu.edu

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The Dynamic Earth

http://www.discoverycube.org

Discovery Science Center is an interactive science center with over 100 hands-on exhibits augmented by educational programming and materials, providing learning opportunities for students, teachers, and family audiences. **The Dynamic Earth** program includes:

- ☐ Resource materials and kits provide the classroom teachers with a set of hands-on materials that will enable students to design and test experiments. The curriculum packet contains science content information, vocabulary list, a materials list, timeline for preparation and implementation, tips for managing the students or classroom during hands-on experiences, a bibliography of additional materials, and a collection of professional contacts.
- ☐ Teacher training program in the use of these materials and lesson plans. This six-hour training, along with the teacher's guide and kit will enable two to three weeks of classroom instruction.
- ☐ An interactive science presentation for the classroom or general public.
- ☐ Family science nights at the science center. These evenings will introduce families to the science programs presented in the schools. Families will observe science demonstrations, attend science lectures, interact with the hands-on exhibitry, such as an earthquake simulation room, an eight-foot free-standing tornado, and a kalliroscope that models the fluid dynamics of the ocean and/or the atmosphere.

Some of the concepts that Dynamic Earth participants will investigate are:

- ☐ Plate tectonics and the changing patterns of land, sea, and mountains on the Earth's surface;
- ☐ How the sun's heating of the Earth's surface drives convection within the atmosphere and oceans, producing winds and ocean currents, leading to an understanding of global weather patterns and geographical distribution of marine and terrestrial organisms; and
- ☐ Human impact on the Earth's atmosphere, and in turn how the altered atmospheric conditions affect all life on Earth.

Interested parties should contact the Education Department or Group Bookings at 714-542-2823.

CONTACT: Janet Yamaguchi, Vice President, Education, Discovery Science Center, 2500 North Main Street, Santa Ana, CA 92705; *Phone:* 714-542-2823; *Fax:* 714-542-2828; *Email:* jyamaguchi@discoverycube.org

Forest Watch

http://www.forestwatch.sr.unh.edu

Forest Watch is an environmental education program developed and run by the Complex Systems Research Center at the University of New Hampshire (UNH). It is designed to introduce both teachers and their students to field, laboratory, and satellite data analysis methods for assessing the state-of-health of local forest stands. Forest Watch provides workshops which are designed to help K–12 teachers introduce their students to selected hands-on techniques for evaluating the health of white pine (Pinus strobus), a bio-indicator for tropospheric ozone damage. Through Forest Watch, students become actively involved in doing meaningful scientific research. Students and teachers set up permanent sampling plots in a forest stand and conduct several ecological and biophysical measurements using scientific protocols. Students collect and help analyze valuable data for UNH researchers while participating in this educationally beneficial program.

Forest Watch has two main objectives: 1) to introduce teachers to techniques that allow students to assess environmental conditions of forest stands and tree species over time; and 2) to provide research scientists an opportunity to assess air pollution impacts to forested species on a regional level. In conducting ecological site assessments, students are introduced to several disciplines of science, such as botany, biology, chemistry and physics, as well as other non-scientific disciplines. Professional development workshops are offered to teachers around the New England region through hands-on activities and field work in order to achieve the project's objectives.

Now in its eleventh year, the Forest Watch program is proving that students can learn science by doing science and that student data and monitoring efforts can assist scientists to assess the impacts of changing air quality on our natural environment.

CONTACT: Dr. Barry Rock, Program Director, or Mr. Ryan Huntley, Program Coordinator, Complex System Research Center, Morse Hall, University of New Hampshire, Durham, NH 03824; *Phone:* 603-862-1792; *Fax:* 603-862-0188; *Email:* forestwatch@unh.edu

The GLOBE Program

http://www.globe.gov

The GLOBE Program is a worldwide network of K–12 students guided by GLOBE-trained teachers in conducting valid Earth science observations at or near their schools. They then report their findings via the Internet to a central database. Scientists use GLOBE data in their research and provide feedback to the students to enrich their education. Maps and

graphs based on GLOBE student data are created on the Web site. This feedback provides "real life" material for student inquiry. GLOBE observations and measurements are in the following study areas: atmosphere, hydrology, land cover, soils, global positioning system (GPS), and phenology/land cover.

In the U.S., there is no cost to participate in the Program. GLOBE supplies educational materials and the interactive Web site, and educational institutions such as universities partner with GLOBE to train teachers. Schools support participation by having one or more teachers attend a GLOBE Training Workshop and make equipment available to students for taking measurements and Internet access for reporting their data. Nobel Laureate Dr. Leon Lederman said "GLOBE is the quintessentially ideal program for involving kids in science."

Teachers and students from over 10,000 schools in over 90 countries currently participate in GLOBE. In the U.S, GLOBE is managed by an interagency team: NASA, NOAA, NSF, and EPA. Other nations administer their own programs.

CONTACT: *Email:* info@globe.gov; *Phone:* 1-800-858-9947.

○ ISS EarthKAM

http://www.earthkam.ucsd.edu/

Earth Knowledge Acquired by Middle School Students (EarthKAM) engages the educational community in inquiry-based learning to explore and understand planet Earth, using remotely-sensed data from the International Space Station. ISS EarthKAM has accumulated a wealth of images, taken remotely by middle school students operating an electronic still camera flown in Earth orbit. These visible-light images show a diversity of regions and physical features, from every continent except Antarctica—all available on the educational, user-friendly, Web-based data system. Educational materials are also available online to help educators get started with the program and integrate working with images into their classrooms and curricula. EarthKAM's main objectives are to:

- ☐ facilitate collaborative, inquiry-based explorations that utilize Earth images in support of national, state, and local education standards; and
- ☐ provide technology-supported learning opportunities in science, geography, and mathematics.

Middle school educators (grades 5–8) also have the opportunity to join the EarthKAM Community; a registration form is available online. The EarthKAM Community provides additional information and support for students and educators as they explore the Earth images and take their own images from the International Space Station.

ISS EarthKAM is a collaboration among NASA; the University of California, San Diego; Texas A&M; and TERC's Center for Earth and Space Science Education.

CONTACT: EarthKAM Coordinator, TERC, 2067 Massachusetts Ave, Cambridge, MA 02140; *Phone:* 617-547-0430; *Fax:* 617-349-3535; *Email:* EarthKAM_Coordinator@TERC.edu

○ The JASON Project

http://www.jasonproject.org

From the depths of the ocean to the heights of the rain forest canopy and from icy polar regions to red-hot volcanoes, **The JASON Project** takes students and teachers on an exciting educational adventure that sparks the imagination of students and enhances classroom experiences. The JASON Project is a multi-disciplinary, educational program that pairs students with leading scientists and experts as they work together to understand the dynamic systems of planet Earth.

Each year, JASON Project staff collaborates with leading scientists, educators, and students to develop year-long curricular materials modeled upon real research. The JASON Project offers a print curriculum filled with research stories, student exercises and masters, assessment tools, teacher preparation, and interdisciplinary links. Engaging video supplements complement this curriculum, highlighting key themes and modeling the work of host researchers. Team JASON Online, the JASON Project's award-winning gated online community, provides additional content, as well as interactivity and community. All of these materials:

- ☐ are fun and engaging,
- ☐ guide teachers and students through an inquiry-based learning experience,
- ☐ emphasize concepts taught in grades 4–9,
- ☐ model national educational standards, and
- ☐ correlate to each state's science, math, social studies, language arts and technology standards

NASA JASON locations include Ames Research Center, Goddard Space Flight Center, and Johnson Space Center. Programs focus on oceans, rainforests, extreme environments, volcanoes, and exploration of inner and outer space. All programs focus on connecting students and teachers with researchers and scientists in the field.

CONTACT: For more information on how to get involved, visit the JASON Project on the Web at **www.jasonproject.org** or call 1-888-527-6600.

NASA Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)

http://icp.giss.nasa.gov

ICP engages students and educators from junior high to graduate school in Earth and space science research alongside world-class scientists. ICP is **NASA GISS'** response to a national challenge to give students a fair start to become productive and responsible citizens in America's workforce and society. More than a program, ICP is a year-round research and education community that represents the country's diversity, including students, educators and researchers from NASA, Columbia University, City University of New York (CUNY), and other area colleges and New York City metro schools. It aims to help teachers connect current research to national science standards and their teaching, to give students a chance to participate in advanced science learning and workforce preparation, and to work with New York museums on climate literacy.

Through direct research experiences focusing on Earth's climate, ICP seeks to help students develop: 1) views of a world that is connected regionally and globally; 2) problem-solving skills; and 3) science understandings about the Earth system that consider science, technology, and society. A different kind of learning and research lab is evolving in the ICP where students and educators work on-site or remotely with scientists to create new knowledge that may help us better understand and predict Earth's climate. After-school research internships are available at GISS and cooperating universities. In-school, ICP faculty involves students in new or enhanced curriculum to develop climate and space science literacy. Full-time summer enrichment programs offer a more intensive research experience. In-service and pre-service teacher workshops are also conducted to share curriculum.

Several ICP spin-off programs are now available as a result of ICP faculty-scientist collaborations. These include: 1) CUNY-wide training programs to address the scientific digital divide via the University's NASA Minority University-SPace Interdisciplinary Network (MU-SPIN)/Network Resources and Training Site (NRTS); 2) research programs via the NASA New York City Space Alliance led by Medgar Evers College and the NASA Partnership for Integrating Research; 3) outdoor science education via a carbon field study in New York's Black Rock Forest; and 4) New York metro area intensive observation periods for schools to contribute to climate and health studies conducted through the GISS Urban Measurement of Aerosol and Asthma Program.

CONTACT: Carolyn A. Harris, ICP Director, GISS at Columbia University, 2880 Broadway at 112th Street, New York, NY 10025; *Phone:* 212-678-5653; *Fax:* 212-678-5552; *Email:* charris@giss.nasa.gov

NASA Student Involvement Program (NSIP)

http://education.nasa.gov/nsip

NASA's national competition for elementary–secondary students, **NSIP** is designed to link students directly with NASA's diverse and exciting missions of research, exploration, and discovery. Annual competitions foster student literacy in science, mathematics, engineering, technology, and geography. Teachers use NSIP to support curricular goals, spark student interest, encourage creative thinking across disciplines, and involve students in science process skills. Program information and entry forms are provided in the annual NSIP Program Announcement, available in print and via the Internet prior to the new school year. Supplemental information is provided in Educator Resource Guides available for each of the competition categories. The 2001–2002 competition included the following categories: Watching Earth Change; My Planet, Earth; Design a Mission to Mars; Science and Technology Journalism; Aerospace Technology Engineering Challenge; and Space Flight Opportunities.

Entries are judged at NASA Centers; students may receive judges' comments about their entry. All qualified entrants receive NASA certificates of participation. Prizes include NASA presentations at schools, and trips to the National Symposium, Student Flight Week, and Space Camp. Beginning in 2000, the Institute for Global Environmental Strategies has awarded the $4,000 Thacher Scholarship to a first-place, high-school Center Winner in the Watching Earth Change competition.

CONTACT: Visit **http://education.nasa.gov/nsip** or call 1-800-848-8429.

Odyssey of the Mind

http://www.odysseyofthemind.com/

NASA is partnering with **Odyssey of the Mind** to develop and sponsor a long-term Earth science problem for their annual competition. Founded in 1978, Odyssey of the Mind is an international creative problem-solving program for students from kindergarten through college, attracting students from 49 states, the District of Columbia and over 30 countries. Odyssey of the Mind competitions involve creative exercises in which teamwork, cooperation and ingenuity are applied to complete various tasks.

Students choose from one of six long-term "problems" and form teams to develop solutions. The problems range in nature from the technical to the artistic, and solutions are judged for creativity, originality, and other criteria. In the spring, teams take their solutions to official competitions at the regional, state/country, and world level.

The NASA-sponsored problem in 2001–2002, named OMER's Earthly Adventures after the raccoon-like Odyssey of the Mind mascot OMER, was a technical problem based on environmental preservation that also incorporated elements of theatrical performance. Students attempted to correct hypothetical environmental problems, and create the illusion of OMER traveling.

In addition to sponsoring a long-term problem, NASA has developed a Web site for Odyssey of the Mind participants, and plans to provide other support services. In May 2002, NASA scientists and engineers attended the Odyssey of the Mind's culminating event of the year, the 2002 World Finals at the University of Colorado at Boulder, to talk with participants about educational opportunities and careers in Earth science with NASA.

CONTACT: Visit the Odyssey of the Mind Web site at **http://www.odysseyofthemind.com** for details on how to participate; or the NASA Odyssey of the Mind Web site at **http://earthobservatory.nasa.gov/odysseyofthemind**

○ PIPELINES

www.phys.subr.edu/pipelines

The **Program to Increase the Pursuit of Education and Learning IN Engineering and Science (PIPELINES)** is a partnership between Southern University and A&M College (SUBR) in Baton Rouge and Iowa State University (ISU).

PIPELINES supports activities in Earth and environmental science for students and teachers in K–12, undergraduates, graduates and university faculty. Major components of the program are:

☐ ***Educational reform and support for standards-based curriculum, teaching, and learning***—Both SUBR and ISU offer in-service workshops designed to promote and support standards-based education, with emphasis on science and mathematics education in general and Earth and environmental science education in particular. These workshops are for pre-college teachers and college faculty. Additionally, the SUBR College of Education's Curriculum Center serves as a statewide repository for instructional materials and supplies for teachers in science and mathematics. The center holds regular workshops to aid teachers in preparing meaningful lessons and activities for students.

☐ ***Global Learning and Observations to Benefit the Environment (GLOBE)***—GLOBE, **http://www.globe.gov**, is a worldwide network of K–12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near their schools and report their data via the Internet. The SUBR-GLOBE Partnership provides GLOBE certification training in the basic GLOBE protocols. Teacher participants receive GLOBE materials and supplies, as well as stipends for after-school, weekend, and holiday sessions.

☐ ***Undergraduate Research Support***—PIPELINES supports twenty high-achieving undergraduate students in science, mathematics, and engineering to conduct Earth science research at NASA Field Centers during the summer or at SUBR or ISU.

☐ ***Earth Science at the Timbuktu Academy (ESTA)*** at SUBR is a six-week residential program that provides intensive academic enrichment designed to enhance the academic achievements of pre-college students (i.e., ACT/SAT). Students are exposed to Earth and environmental science education and research, through GLOBE, and to career opportunities. Future college matriculation in Earth science related fields is a major objective of this activity. The Science Bound Program, at ISU, similarly engages pre-college students in academic enrichment activities.

CONTACT: Diola Bagayoko, Program Director; *Phone:* 225-771-2370; *Fax:* 225-771-4341; *Email:* bagayoko@aol.com—or: Paulette Baptiste-Johnson, Program Administrator, *Phone:* 225-771-2730; *Fax:* 225-771-4341; *Email:* pbaptistejohnson@aol.com

○ Project SUN—Students Understanding Nature

http://sunshine.jpl.nasa.gov

NASA's Genesis Mission currently sponsors **Project SUN** as part of its outreach effort to instill knowledge in students about the natural links between the Earth and sun. It is also carried out in partnership with the Astronomy and Physics Department and the College of Extended Learning, California State University, Northridge (CSUN). Project SUN is a component of the CSUN International Science Network (ISN).

Through Project SUN, secondary students all over the world are contributing to long-term, time-resolved, monitoring of both visible and UV radiation on the Earth's surface. Data is usually transmitted to NASA's Jet Propulsion Laboratory (JPL) via the Internet. Participating schools purchase their own equipment, total cost about $600, not including the cost of a computer supplied by the school to

use for the data logger. Schools agree to supply NASA JPL at least two days of data per week for a full school year. The equipment can be used the other three days for individual research projects such as investigating the efficiency of different items of solar energy equipment, use of UV skin blockers, effects of enhanced UV radiation on plants, etc. It is hoped each school will integrate Project SUN as a continuing program, using the concept of a school research team, just as the school has established athletic teams.

A new aspect of Project SUN will soon be introduced. This adjunct research will be to see if any correlation's can be made between changes in the solar wind and observed surface conditions.

The components of Project SUN are: 1) low cost, scientifically accurate instrumentation; 2) computer interfacing coupled with old computers such as the Apple IIE, Apple IIC, Macintosh, and old IBM compatibles used as dedicated data loggers; 3) appropriate software and curriculum; and 4) a detailed operating strategy and a system of inservice teacher training. Part of this training is via the CSUN course Physics 595s, Solar Flux Detection, which is taught over the Internet by Dr. Gilbert Yanow.

Very careful, annual re-calibration of the commercial instruments and a continuing program of instrumentation quality control done in cooperation with the manufacturers to maintain the accuracy of the data.

CONTACT: Gilbert Yanow, NASA Jet Propulsion Laboratory, Mail Stop 264-370, 4800 Oak Grove Dr., Pasadena, CA 91109; *Phone:* 818-354-8060, *Fax:* 818-393-1392; *Email:* gilbert.yanow@jpl.nasa.gov

○ Students' Cloud Observations Online (S'COOL) Project

http://scool.larc.nasa.gov

S'COOL is a component of NASA's Clouds and the Earth's Radiant Energy System (CERES) project. The first CERES instrument was launched in late 1997 to provide global data on clouds. The 2nd and 3rd instruments were launched on the Terra spacecraft in December 1999. S'COOL Project participants make ground truth measurements for the CERES experiment. Ground truth measurements are land-based observations to compare with satellite data for the purpose of improving the satellite results.

Participating classes are asked to make basic weather observations and to record the type and features of clouds in the sky at the time that the satellite passes over their location. Observations are then either entered in an online form or emailed, faxed, or mailed to NASA for entry into an online database. Students have access to their results as well as those from other participating schools. Satellite observations for matching times will also be captured so that CERES scientists can evaluate the results and students can compare their observations to the satellite's.

Participants will receive some instructional materials, satellite overpass times, and information necessary for reporting results. There is no cost to participate.

In addition, a week-long teacher workshop is held each summer at NASA Langley Research Center, allowing participating teachers to obtain an in-depth understanding of the related scientific issues to the S'COOL.

CONTACT: Send an email to: scool@larc.nasa.gov, or write to: Attn: S'COOL, Mail Stop 420, NASA Langley Research Center, Hampton, Virginia 23681-2199 USA. The following information is requested: name of teacher; name of school and grade/age level (minimum of 3rd grade is suggested); postal and email (if available) address; whether or not the class has Internet access; location (city, state and country, as well as latitude and longitude).

○ Student's Online Atmospheric Research (SOLAR)

http://www-sage3.larc.nasa.gov/solar

SOLAR is the outreach component of NASA's Stratospheric Aerosol and Gas Experiment III (SAGE III). SAGE III will provide long-term data on the abundance and global distributions of aerosols, ozone, and other trace gases in the atmosphere, which will enable scientists to assess possible influences of human activities and natural events on the Earth's climate system and other atmospheric processes such as ozone depletion.

SOLAR outreach offers a broad range of science topics related to the Earth's atmosphere, including topics that are especially relevant to science issues addressed by SAGE III. For example, SOLAR highlights some of the major questions regarding the health of the atmosphere, such as possible influences of aerosols on global climate and atmospheric processes related to ozone depletion. SOLAR is geared toward helping teachers bring these topics into the classroom. For example, SOLAR conducts workshops and other special presentations to familiarize science teachers with these and other related topics, and with research being conducted by NASA in these areas. The focus of the workshops is to help teachers integrate these topics into their curriculum, and align the topics with learning standards. The SOLAR Web site also presents tutorial discussions on related atmospheric topics.

SOLAR emphasizes involving students in hands-on learning activities. One such activity, selected for middle and high school, helps students develop skills in working with scientific equipment and collecting, analyzing, and reporting scientific data. It involves building a sun photometer, using inexpensive components and instructions supplied by SOLAR. The students, under the guidance of their teacher, will learn to calibrate and use the instrument to measure optical thickness of the atmosphere. Their data can give a qualitative assessment of the amount of aerosol or haze in the atmosphere. This basic measurement concept is fundamentally very similar to that employed by SAGE III.

CONTACTS: David C. Woods, Mail Stop 475, NASA Langley Research Center, Hampton, VA 23681; *Phone:* 757-864-2672; *Fax:* 757-864-2671; *Email:* d.c.woods@larc.nasa.gov

Susan C. Walters, Mail Stop 475, SAIC/NASA Langley Research Center, Hampton, VA 23681; *Phone:* 757-864-5879; *Fax:* 757-864-2671; *Email:* s.c.walters@larc.nasa.gov

Susan W. Moore, Mail Stop 475, SAIC/NASA Langley Research Center, Hampton, VA 23681; *Email:* s.w.moore@larc.nasa.gov

○ Visiting Student Enrichment Program

http://esdcd.gsfc.nasa.gov/VSEP

The **Visiting Student Enrichment Program (VSEP)** offers students summer employment with the Goddard Earth Sciences and Technology Center (GEST), working with NASA/Goddard Space Flight Center's (GSFC) scientists. Student projects have included simulating neural networks, preparing image analysis algorithms on supercomputers, developing computational science applications, and creating interactive Web sites.

The program is open to full-time students in computer science, the physical sciences, and mathematics. Participants must be either U.S. citizens or foreign nationals in U.S. schools who are either permanent residents or who possess a valid F1 work visa. All selected students will be subject to a pre-employment security background check under current security guidelines. Undergraduate and graduate students must have taken courses in physical and computer sciences directly related to their areas of study. High school students will be evaluated with emphasis on their potential and related extracurricular experiences, as well as on course work. The number of positions available for high school students is limited.

In 2002, project experiences are available from June 10 to August 16, 2002 (high school students may start/stop later subject to housing availability), at GSFC in Greenbelt, MD. Students are provided opportunities to work with scientists and professionals at a world-class facility while experiencing meaningful work through a project primarily focused on computer science or the application of computers to solve problems in other sciences. VSEP also offers field trips and lectures to broaden appreciation for GSFC's mission and activities.

The program now encompasses more than seven divisions at GSFC, usually including the following related to the Earth sciences: Laboratory for Atmospheres, the Global Change Data Center, the Laboratory for Hydrospheric Processes, and the Space Data and Computing Division in the Earth Sciences Directorate.

CONTACT: Marilyn Mack, NASA GSFC, Code 933, Greenbelt, MD 20771; *Phone:* 301-286-4638; *Email:* marilyn.mack@gsfc.nasa.gov

○ You Be the Scientist with Satellite Imagery in EZ/EC Communities

http://nia.ecsu.edu/nrts/ess/ezec/ezec.html

You Be the Scientist with Satellite Imagery in EZ/EC Communities is a student enrichment project for six targeted middle schools located in the economic empowerment zone communities of Portsmouth, VA and Halifax, NC. The student enrichment component is designed to support extracurricular science activities that will increase awareness and use of GOES weather satellite data. The program is helping students meet core Earth Science learning objectives and to develop marketable skills in the area of computer technology. The You Be the Scientist program launches students into the 21st century with organized integrated science and technology educational enrichment activities.

The program also exposes students to a variety of careers available in research, data analysis, applications, and computer visualization.

Elizabeth City State University (ECSU) conducts this project, at which the NASA Minority University-SPace Interdisciplinary Network (MU-SPIN) has established a Network Resources and Training Site (NRTS). ECSU brings satellite imagery to middle schools in its region in an effort to enhance mathematics and science studies by underrepresented minority students. The program is designed to aggressively strengthen the current Earth system science outreach to EZ/EC middle schools by NASA and the ECSU-NRTS.

CONTACT: Dr. Linda Bailey Hayden, NASA Network Resources and Training Site, Elizabeth City State University, Box 672, 1704 Weeksville Rd., Elizabeth City, NC 27909; *Phone:* 252-335-3696; *Fax:* 252-335-3790; *Email:* lhayden@umfort.cs.ecsu.edu

UNDERGRADUATE & GRADUATE

○ Center for Hydrology, Soil Climatology, and Remote Sensing's Undergraduate Summer Enrichment Program

http://hscars1.saes.aamu.edu

The **Center for Hydrology, Soil Climatology, and Remote Sensing** at Alabama A&M University in Huntsville conducts an Undergraduate Summer Enrichment Program, which provides summer research opportunities for undergraduate minority and female students in Earth system science. Interns are selected from a pool of highly-qualified student applicants from across the nation. This program provides for an eight-week period of residence at Alabama A&M University, where students have the opportunity to work with a researcher/mentor from Alabama A&M or the Global Hydrology Climate Center on general research areas (e.g., micrometeorology, soil data analysis, hydrologic modeling, geographic information systems, soil hydrology, or computer science). Research papers resulting from the interns' summer projects have been presented at various national conferences. Posters describing the program are mailed in January. Applications are available on the project Web page.

CONTACT: Ms. Phyllis Campbell, HSCaRS, Alabama A&M University, Normal, AL 35762, *Phone:* 256-851-5076; *Email:* pcampbell@aamu.edu

○ Center for the Study of Terrestrial and Extraterrestrial Atmospheres (CSTEA)

http://cstea.howard.edu

CSTEA is a NASA University Research Center (URC)—multidisciplinary research units established at minority institutions to focus on a specific area of NASA interest. CSTEA is committed to training students in space-based and atmospheric sciences. The Center, a component of Howard University's Program in Atmospheric Sciences (HUPAS), actively engages tudents in CSTEA research. The Howard University Graduate School (HUGS) also offers a wide array of graduate-level courses leading to the Master of Science or Doctor of Philosophy degree. These courses are taught in the Departments of Physics, Chemistry, Mechanical and Electrical Engineering.

Students are able to work with a variety of research mentors from Howard University, NASA, and the National Oceanic and Atmospheric Administration (NOAA).

Undergraduate students receive a yearly stipend. Graduate students may qualify for tuition, fees, and stipend packages worth up to $34,000 per year.

CONTACT: Demetrius Venable, Director, Center for the Study of Terrestrial and Extraterrestrial Atmospheres, Howard University, 2216 6th Street NW, Room 103, Washington, DC 20059; *Phone:* 202-806-5172; *Fax:* 202-806-4430; *Email:* dvenable@howard.edu

○ Curriculum Improvement Partnership Award Program (CIPA)

http://mured.nasaprs.com

The **CIPA Program** provides support to two and four-year minority institutions who have received limited funding from NASA. CIPA is designed to strengthen curricula and technical programs directly related to the NASA mission. The specific objectives are to:

- ☐ increase the quality and quantity of NASA-related science, mathematics, engineering, and technology curricula at nine minority institutions; and
- ☐ increase the number of minority students at the pre-college and college levels that study science, mathematics, engineering, and technology and that choose careers in NASA-related fields.

The 2002 CIPA awardees with an Earth science focus are:

North Carolina Central University
Training Incoming Students to be Scientists and Engineers (TISSE)
Principal Investigator: Dr. Walter Harris, *Email:* wharris@wpo.nccu.edu

Universidad Politecnica de Puerto Rico
Modern Physics Laboratory
Principal Investigator: Dr. Edbertho Leal-Quiros, Ph.D., *Email:* eleal@pupr.edu

Cheyney University
Cheyney University's 21st Century Workforce Development
Principal Investigator: Dr. Warren E. Gooden, *Email:* cpettus@cheyney.edu

Keweenaw Bay Ojibwa Community College
Keweenaw Bay Earth Science Diversity Initiative for Native American Students
Principal Investigator: Treneice Marshall, *Email:* tjmarsha@mtu.edu

Universidad Metropolitana
GIS and Environmental Informatics: Novel Program in Puerto Rico
Principal Investigator: Dr. Alberto Rivera Rentas, *Email:* ac_alrivera@suagm.edu

Essex County College
Environmental Science Curriculum Development
Principal Investigator: Dr. Jeffrey Lee, *Email:* lee@essex.edu

Harold Washington College–City College of Chicago
NASA-Based Modular Chemistry: Curriculum Reform at Harold Washington College
Principal Investigator: Dr. Thomas Higgins, *Email:* tbhiggins@ccc.edu

San Jacinto College North
Expanding and Developing NASA-Related Curriculum in the Gulf Coast Colleges
Principal Investigator: Dr. Sarah Percy Janes, *Email:* sjanes@sjcd.cc.tx.us

Wiley College
The Wiley College Computer-Based Mathematics Center and the Science Academy for Kids
Principal Investigator: Mrs. Sarah Bush, *Email:* sbush@wileyc.edu

CONTACT: CIPA is a program of NASA's Minority University Research and Education (MURED) program. It is administered by United Negro College Fund Special Programs (UNCFSP). For further information contact Aaron Andrews at 703-205-7640 or visit the UNCFSP Web site at **http://www.uncfsp.org**

○ Earth System Science Fellowship Program

http://research.hq.nasa.gov/code_y/code_y.cfm

NASA offers graduate student training fellowships for persons pursuing a Master of Science (M.Sc.) or Doctoral (Ph.D.) degree in Earth system science. The purpose of these fellowships is to ensure continued training of interdisciplinary scientists to support the study of the Earth as a system.

Applications to the Earth System Science Fellowship Program will be considered for research in the following areas:

- ☐ Biology and Biogeochemistry of Ecosystems, and their role in the Earth system, and the Global Carbon Cycle
- ☐ Atmospheric Chemistry, Aerosols, and Solar Radiation
- ☐ Global Water and Energy Cycle
- ☐ Oceans and Ice in the Earth System
- ☐ Solid Earth Science

Research will also be considered in atmospheric chemistry and physics, ocean biology and physics, ecosystem dynamics, hydrology, cryospheric processes, geology, geophysics, and information science and engineering, provided that it is relevant to NASA's program in support of the U.S. Global Change Research Program (USGCRP). NASA discourages submission of paleo-climate related applications to this program. Additional information about the Earth Science Enterprise—e.g., its scientific priorities, research strategy, and recent accomplishments—can be found at **http://www.earth.nasa.gov**

Students admitted or enrolled in a full-time M.Sc. and/or Ph.D. program at accredited U.S. universities are eligible to apply. The deadline for application is March 15 of each year; the results are announced by June 30, with an anticipated award date of September 1 of the same year.

Awards are made initially for one year and may be renewed annually, no more than two additional years for a total of three years, based on satisfactory progress. The amount of the award is $24,000/annum, which may be used to defray student's stipend, living and educational expenses, travel expenses to scientific conferences, tuition, and fees.

Note that additional Earth Science research opportunities are available at NASA Field Centers through the GSRP. A student may apply to both the ESS Fellowship Program and the GSRP (see separate entry and note different schedule). Those GSRP applications that check both "HQ" and "Earth Science" are grouped with the applications to the ESS Fellowship Program for evaluation and selection.

CONTACT: Earth System Science Fellowship Program, Code Y, NASA Headquarters, Washington, DC 20546; *Phone:* 202-358-0855; *Email:* acrouch@hq.nasa.gov

○ Goddard Space Flight Center/Howard University Fellowship in Atmospheric Science (GoHFAS)

GoHFAS is a partnership between Howard University and GSFC's Laboratory for Atmospheres. The overall goal of GoHFAS is to facilitate the transition from undergraduate to graduate school by exposing students to solving open-ended problems and conducting research. This is accomplished through year-long interaction between students and mentors from participating organizations, including an eight-week summer program and travel back to the research site during the students' winter break to continue work on their projects. The ultimate goal is to increase the number of underrepresented minorities in the atmospheric sciences. Participants are juniors at U.S. universities with majors in the physical sciences and emphasizing: atmospheric science, chemistry, physics, or related engineering disciplines. Students must have a minimum of one year of college-level calculus and physics or chemistry.

CONTACT: Sonya T. Smith, Howard University; *Phone:* 202-806-4837; *Email:* ssmith@howard.edu

Graduate Student Summer Program in Earth System Science

http://www.umbc.edu/gest/studentop/summer.html

The Goddard Space Flight Center's Earth Sciences Directorate, in collaboration with the Goddard Earth Sciences and Technology (GEST) Center with headquarters at the University of Maryland Baltimore County, is offering a limited number of graduate student research opportunities for the summer of 2002. The program is scheduled for June 10 to August 16, 2002. The program is designed to stimulate interest in interdisciplinary Earth science studies by enabling selected students to pursue specially tailored research projects in conjunction with Goddard scientific mentors. This year's theme is the Global Water Cycle and Climate Change.

Each student will be teamed with a NASA scientist mentor with parallel scientific interests to jointly develop and carry out an intensive research project at GSFC over the ten-week period. NASA mentors will be drawn from the four participating Earth Science laboratories at Goddard: The Laboratory for Atmospheres, The Goddard Institute for Space Studies, The Laboratory for Hydrospheric Processes, and The Laboratory for Terrestrial Physics. Students will be expected to produce final oral and written reports on their summer research activities.

The program is open to students enrolled in or accepted to accredited U.S. graduate programs in the Earth, physical or biological sciences, mathematics, or engineering disciplines. Preference will be given to students who have completed at least one year of graduate study. Minorities and women are encouraged to apply. Participants must be either U.S. citizens or foreign nationals in U.S. schools who are either permanent residents or who possess a valid F1 visa. All selected students will be subject to a pre-employment security background check under the current security guidelines. Applications for the 2002 program are due February 15, 2002. Selection announcements will be made before April 5, 2002.

CONTACT: L. Anathea Brooks, Acting Associate Director, GEST Center, Mail Code 900.1, NASA Goddard Space Flight Center, Greenbelt, MD 20771;
Phone: (301) 286-4099;
Email: abrooks@research.umbc.edu

NASA Academy

http://www.nasa-academy.nasa.gov

NASA's charter gives it the main role of using and exploring space for the benefit of humankind. The success of the space program results from the interaction of government, academia, and the private sector, each playing a critical and different role. Responsibilities overlap, leaders migrate from one sector to another, and interdependence changes with each new administration. The **NASA Academy** is a unique institute of higher learning whose goal is to help guide future leaders of our space program by giving them a glimpse of how this system works.

The program's intent is to give participating students a working knowledge of NASA and its programs. The Academy accomplishes this through interactive sessions with leaders within government, industry, and academia and research in NASA's laboratories. The students will discover how NASA and its Field Centers operate, understand the NASA link to the private sector, gain experience in world-class laboratories, participate in a team environment where people work together to accomplish common goals, and build professional bonds among our future leaders.

The NASA Academy was initially started in 1993 at Goddard Space Flight Center (GSFC). NASA Academies are currently active at GSFC and Ames Research Center.

Student eligibility requirements include:

- ☐ a demonstrated interest in the space program;
- ☐ enrollment (as of June 1 of the program year) as a junior, senior, or early graduate student;
- ☐ a minimum B average;
- ☐ a major in science (physics, chemistry, biology, etc.), mathematics, engineering, computer science, or other area of interest to the space program; and
- ☐ citizenship or permanent residence (as of June 1 of the program year).

The NASA Academy is co-sponsored by the National Space Grant College and Fellowship Program, which provides students with stipends between $3,000 and $4,000 for the summer. Housing, meals, and local transportation are paid for by the participating NASA Center. The deadline for filing applications for the 2002 NASA Academy is January 31, 2002.

CONTACT: For application materials, please check the NASA Academy Home Page: **http://www.nasa-academy.nasa.gov**, your local Space Grant College Consortia Office: **http://calspace.ucsd.edu/spacegrant**, or call the University Programs Office, NASA GSFC, at 301-286-0904.

20

NASA Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)

http://icp.giss.nasa.gov

ICP engages students and educators from junior high to graduate school in Earth and space science research alongside world-class scientists. ICP is NASA GISS' response to a national challenge to give students a fair start to become productive and responsible citizens in America's workforce and society. More than a program, ICP is a year-round research and education community that represents the country's diversity, including students, educators and researchers from NASA, Columbia University, City University of New York (CUNY), and other area colleges and New York City metro schools. It aims to help teachers connect current research to national science standards and their teaching, to give students a chance to participate in advanced science learning and workforce preparation, and to work with New York museums on climate literacy.

Through direct research experiences focusing on Earth's climate, ICP seeks to help students develop: 1) views of a world that is connected regionally and globally; 2) problem-solving skills; and 3) science understandings about the Earth system that consider science, technology, and society. A different kind of learning and research lab is evolving in the ICP where students and educators work on-site or remotely with scientists to create new knowledge that may help us better understand and predict Earth's climate. After-school research internships are available at GISS and cooperating universities. In-school, ICP faculty involves students in new or enhanced curriculum to develop climate and space science literacy. Full-time summer enrichment programs offer a more intensive research experience. In-service and pre-service teacher workshops are also conducted to share curriculum.

Several ICP spin-off programs are now available as a result of ICP faculty-scientist collaborations. These include: 1) CUNY-wide training programs to address the scientific digital divide via the University's NASA Minority University-SPace Interdisciplinary Network (MU-SPIN)/Network Resources and Training Site (NRTS); 2) research programs via the NASA New York City Space Alliance led by Medgar Evers College and the NASA Partnership for Integrating Research; 3) outdoor science education via a carbon field study in New York's Black Rock Forest; and 4) New York metro area intensive observation periods for schools to contribute to climate and health studies conducted through the GISS Urban Measurement of Aerosol and Asthma Program.

CONTACT: Carolyn A. Harris, ICP Director, GISS at Columbia University, 2880 Broadway at 112th Street, New York, NY 10025; *Phone:* 212-678-5653; *Fax:* 212-678-5552; *Email:* charris@giss.nasa.gov

NASA Graduate Student Researchers Program (GSRP)

http://education.nasa.gov/gsrp

GSRP awards fellowships for graduate study leading to research-based masters or doctoral degrees in the fields of science, mathematics, and engineering. Earth science research opportunities are available at NASA Centers, including: Ames Research Center, Goddard Space Flight Center, Jet Propulsion Laboratory, Langley Research Center, Marshall Space Flight Center, and Stennis Space Center. Full descriptions of research areas that will be supported are provided on the GSRP Web site. Note that the GSRP also supports the Earth System Science Fellowship Program (see separate entry) with NASA Headquarters.

Fellowships are awarded for one year as training grants not to exceed $24,000 and are renewable for a total of three years based on satisfactory academic advancement, research progress, and available funding. All applicants must be either currently enrolled as full-time graduate students in an accredited U.S. college or university or making plans to enroll as a full-time student. Applicants must be citizens of the U.S. and may apply to the program prior to receiving their baccalaureate degrees or any time during their graduate work. Students who apply prior to acceptance in graduate school must submit a list of prospective schools, and if selected, must provide proof of acceptance prior to an award. All applicants must have a faculty advisor or graduate department chair sponsor. An individual accepting this award may not concurrently receive other Federal fellowships or traineeships.

CONTACT: Visit the GSRP Web site at: **http://education.nasa.gov/gsrp** for details about research areas that are supported, eligibility, proposal submission, and application process.

NASA Summer School for High Performance Computational Earth and Space Sciences

http://www.umbc.edu/gest/studentop/nasa.html

The NASA Goddard Space Flight Center's (GSFC) Earth and Space Data Computing Division (ESDCD) and the Goddard Earth Sciences and Technology Center (GEST) conduct an intensive summer lecture series in

computational Earth and space sciences for graduate students. The ESDCD provides comprehensive research and development support in data handling and computing for NASA Earth and space science research programs. Resident facilities include a 416-processor Compaq (current aquisition), a 1360-processor Cray T3E, a 512-processor SGI Origin 3000, numerous middle-sized supercomputing platforms, and several Beowulf-class systems. Beowulf is a class of inexpensive massively-parallel systems designed as a cluster of commodity PCs using LINUX, first conceived at GSFC in the 90s.

Approximately 15 students will be selected to participate in the three-week program. Students will be given hands-on computer training and small group interaction experience. Staff and invited computational scientists will present a series of lectures on advanced topics in computational Earth and space sciences, with emphasis on computational fluid dynamics and particle methods. Lectures will be presented on developing software for massively parallel architectures. Students are encouraged to give a presentation of their thesis research interests during the course of the summer school.

The program aims to attract Ph.D. students in the Earth and space science disciplines whose present or future research requires large-scale numerical modeling on massively parallel architectures. Eligibility is limited to those Earth and space science students who are U.S citizens, are enrolled in U.S. universities, and have passed their Ph.D. qualifying exams. Participants receive a stipend, housing, and will be reimbursed for domestic transportation to and from Greenbelt, Maryland.

The 2002 program wll be held July 8–26. Application materials received before February 18, 2002 will receive full consideration. See the project Web site for details on how to apply.

CONTACT: L. Anathea Brooks, Acting Associate Director, GEST Center, Mail Code 900.1, NASA Goddard Space Flight Center, Greenbelt, MD 20771; *Phone:* 301-286-4099; *Email:* abrooks@research.umbc.edu

○ NASA Undergraduate Student Research Program (USRP)

http://education.nasa.gov/usrp

NASA sponsors the **NASA Undergraduate Student Research Program (USRP)**, offering undergraduates across the United States mentored research experiences at NASA Centers. Two sessions will be offered in 2002: 10 weeks during Summer 2002 and 15 weeks during Fall 2002.

Applicants must be rising juniors or seniors during the Spring 2002 semester/quarter, enrolled full-time in an accredited U.S. college or university. Eligible fields of study are an academic major or demonstrated coursework concentration in Earth sciences, engineering, mathematics, computer science, or physical/life sciences. Research areas supported by USRP vary among NASA Centers; please see the USRP Web site for details.

The NASA-USRP consists of a 10–15 week research experience at a participating NASA Center under the supervision of a NASA technical mentor. Selected students must be available to work 10 consecutive weeks at 40 hrs. per week during the Summer 2002 session (dates to be determined by Centers between late May 2002 and mid-Aug. 2002) or 15 consecutive weeks at 40 hrs. per week during the Fall 2002 session (dates to be determined by Centers between mid-Aug. 2002 and mid-Dec. 2002).

Students will receive a $5,000 (summer session) or $7,500 (fall session) stipend for the research experience plus one round-trip airfare or ground transportation costs to and from the NASA Host Center. A housing allowance will be provided for students at specific high cost NASA Centers. At the completion of the research session, students must submit a paper on their NASA-USRP research experience. Students may also be asked to discuss their research in public forums and/or participate in NASA-sponsored colloquia, workshops, and technology demonstrations.

CONTACT: See **http://education.nasa.gov/usrp** for details about research areas that are supported, eligibility, proposal submission, and application process.

○ National Space Grant College and Fellowship Program (NSGCFP)

http://www.hq.nasa.gov/spacegrant

NSGCFP funds support graduate and undergraduate students throughout the 50 states, District of Columbia, and Puerto Rico. The criteria (recruitment and selection) are at the discretion of the consortia. However, all must be U.S. citizens and enrolled full-time in a degree program related to aerospace which includes aeronautics, Earth and space science, space engineering, and related fields.

Designated Space Grant institutions provide specialized training and education programs to help maintain the United States' capabilities in aerospace science and technology and education, and to capitalize on the multiple opportunities afforded by the space environment. Each state consortium is challenged to establish a national network of universities with interests and capabilities in aeronautics, space, and related fields; to encourage coopera-

tive programs among universities, aerospace industry, and federal, state, and local governments; to encourage interdisciplinary training, research, and public service programs related to aerospace; to recruit and train professionals, especially women, underrepresented populations, and persons with disabilities, for careers in aerospace science and technology; and to promote a strong science, mathematics, and technology education base from elementary through secondary levels.

CONTACT: See **http://www.hq.nasa.gov/spacegrant** to connect to the NASA Space Grant institution in your state.

○ PACES Scholars

http://nasa.utep.edu/pacesscholars/index.html

PACES Scholars is a student enrichment program at the University of Texas at El Paso. It is part of the Pan American Center for Earth and Environmental Studies (PACES), one of NASA's University Research Centers—multidisciplinary research units established at minority institutions to focus on a specific area of NASA interest. The PACES Scholars program emphasizes monthly seminars on Earth and space science, graduate school, and internship opportunities. Not only is there an all-expenses paid field trip to a NASA facility, but students also receive a stipend.

PACES Scholars is open to juniors at UTEP in Electrical and Computer Engineering and Computer Science. You must be a U.S. citizen to apply.

CONTACT: Dr. Scott Starks or Ms. Michelle Kistenmacher, PACES, University of Texas at El Paso, El Paso, Texas; *Email:* michsmi@utep.edu

○ Partnership Awards for the Integration of Research into Undergraduate Education (PAIR)

http://mured.nasaprs.com

The purpose of the **PAIR** program is to integrate cutting-edge NASA-related research into the undergraduate educational experience, to strengthen teaching and research strategies across academic programs, and to enhance collaboration among mathematics, science, engineering, and technology (MSET) academic departments, thereby strengthening the MSET baccalaureate degree-producing capacity of a number of the nation's Historically Black Colleges and Universities and Other Minority Institutions (OMIs), which include Hispanic Serving Institutions (HSIs) and Tribal Colleges and Universities (TCUs). The PAIR program provides an opportunity for these institutions to build upon their NASA-sponsored and NASA-related research across academic disciplines by creating innovative approaches to the interdisciplinary study of MSET.

The cross-disciplinary partnership spans more than one MSET academic program, creating a collaborative effort among different MSET departments. Other partners may include NASA Centers and the Jet Propulsion Laboratory (JPL) and other institutions of higher education and the aerospace community, having substantial involvement in NASA's mission to strengthen the MSET academic infrastructure of minority institutions.

PAIR Awards with an Earth Science Focus are:

Clark Atlanta University
Integration of research and Education in the Area of Earth Systems Science
Dr. C. Williams, *Email:* cwilliams@cau.edu

City University of New York City College
Integration of Research and Education in Remote Sensing and Environmental/Climate Studies
Dr. R. Khanbilvardi, *Email:* rk@ce-mail.engr.ccny.cuny.edu

Hampton University
The center for Lidar and Atmospheric Sciences Students (CLASS)
Dr. D. Temple, *Email:* doyle.temple@hamptonu.edu

University of Puerto Rico at Mayaguez
Partnership for Spatial and Computational Research
Dr. L. Morell, *Email:* Lueny@ece.uprm.edu

California State University at Northridge
Analyzing Data Sets
Dr. C. Shubin, *Email:* carol.Shubin@csun.edu

Norfolk State University
Mission Leveraged Education: NSU-NASA Innovative Undergraduate Model
Dr. W. Rodriguez, *Email:* wjrodriguez@nsu.edu

CONTACT: Mabel Jones Matthews, Office of Equal Opportunity Programs, NASA Headquarters, Code E, Washington, DC 20546-0001; *Email:* mmatthew@hq.nasa.gov.

○ PIPELINES

www.phys.subr.edu/pipelines

The **Program to Increase the Pursuit of Education and Learning IN Engineering and Science (PIPELINES)** is a partnership between Southern University and A&M College (SUBR) in Baton Rouge and Iowa State University (ISU). PIPELINES supports activities in Earth and environmental science for students and teachers in K–12, undergraduates, graduates and university faculty. Major components of the program are:

☐ ***Educational reform and support for standards-based curriculum, teaching, and learning***—Both SUBR and ISU offer in-service workshops designed to promote and support standards-based education, with emphasis on science and mathematics education in general and Earth and environmental science education in particular. These workshops are for pre-college teachers and college faculty. Additionally, the SUBR College of Education's Curriculum Center serves as a statewide repository for instructional materials and supplies for teachers in science and mathematics. The center holds regular workshops to aid teachers in preparing meaningful lessons and activities for students.

☐ ***Global Learning and Observations to Benefit the Environment (GLOBE)***—GLOBE, **http://www.globe.gov,** is a worldwide network of K–12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near their schools and report their data via the Internet. The SUBR-GLOBE Partnership provides GLOBE certification training in the basic GLOBE protocols. Teacher participants receive GLOBE materials and supplies, as well as stipends for after-school, weekend, and holiday sessions.

☐ ***Undergraduate Research Support***—PIPELINES supports twenty high-achieving undergraduate students in science, mathematics, and engineering to conduct Earth science research at NASA Field Centers during the summer or at SUBR or ISU.

☐ ***Earth Science at the Timbuktu Academy (ESTA)*** at SUBR is a six-week residential program that provides intensive academic enrichment designed to enhance the academic achievements of pre-college students (i.e., ACT/SAT). Students are exposed to Earth and environmental science education and research, through GLOBE, and to career opportunities. Future college matriculation in Earth Science related fields is a major objective of this activity. The Science Bound Program, at ISU, similarly engages pre-college students in academic enrichment activities.

CONTACT: Diola Bagayoko, Program Director; *Phone:* 225-771-2370; *Fax:* 225-771-4341; *Email:* bagayoko@aol.com—or: Paulette Baptiste-Johnson, Program Administrator, *Phone:* 225-771-2730; *Fax:* 225-771-4341; *Email:* pbaptistejohnson@aol.com

○ Remote Sensing of Tribal Lands

Salish Kootenai College is providing research experiences in Earth system science to Native American undergraduate students. A new upper division course **Remote Sensing of Tribal Lands** has been developed within the SKC B.S. in Environmental Science degree program. This course covers the application of remote-sensing technologies to the study of the Earth as a system and focuses in particular on the place of Montana tribal lands in the Earth system. Fifteen students per year are gaining introductory research experience in this class by completing a term research project that utilizes remote sensing, geographic information systems, and global positioning system technologies.

Six undergraduate research internships are also provided each year, which focus on applying remote-sensing data and Earth system modeling to the solution of important environmental problems on tribal lands. These students work under the supervision of SKC researchers. The project Web site publicizes the educational opportunities in Earth system science at Salish Kootenai College, disseminates student research results and NASA Earth Observing System data products covering Native lands, and emphasizes the importance of NASA's Earth Science Enterprise to Native peoples.

CONTACT: Tim Olson, Salish Kootenai College, PO Box 117, Pablo, MT 59855; *Phone:* 406-675-4800, ext. 305; *Fax:* 406-675-4801; *Email:* tim_olson@skc.edu

○ STEP Careers in Research Exploration Program

The purpose of this project is to expose the Montana Tech **STEP** students **(Succeeding sTudents in Engineering Programs)** to remote sensing and to spark their interest in research-based careers. STEP is a support program that works with traditionally underrepresented students to encourage them to succeed in earning an engineering education and becoming a successful professional. Each year the STEP program accepts twenty recent high-school graduates into the program. They attend classes and academic excellence workshops for six weeks in the summer while living on campus. The classes include but are not limited to, college success, introduction to engineering, and English composition. Starting summer 2000, an additional class is being offered in the field of remote sensing. The majority of the class time is spent conducting research with faculty members who are currently doing NASA research at Montana Tech.

Upon completing the six-week summer program, all STEP students enroll at Montana Tech in one of the seven engineering programs offered. STEP works with students to develop academic and personal success strategies from college entrance until maturation and placement. Along with other STEP program requirements, students will write reports about their remote-sensing research experience and the careers that the experience may lead to, supported by a plan for reaching

the career goal(s). The STEP program then tracks student's success at following their career goal plan and assists them in attaining their goals.

The objectives of the STEP Careers in Research Exploration Program are to:

- ☐ enhance the knowledge of remote sensing and Earth system science of STEP participants through research;
- ☐ develop students' ability to conduct scientific research;
- ☐ encourage students to pursue an education in engineering or technology;
- ☐ improve tribal technology, science, and mathematics education by providing positive Native American role models to high school students; and
- ☐ expose students to the career opportunities available in the fields of remote sensing and Earth system science.

CONTACT: Dr. Thomas S. Moon, Professor, Geophysical Engineering, Montana Tech of the University of Montana, 1300 West Park Street, Butte, MT 59701; *Phone:* 406-496-4350; *Fax:* 406-496-4704; *Email:* tmoon@mtech.edu—or: STEP Program Director, Amy Verlanic, Technical Outreach Department, STEP Program, Montana Tech of the University of Montana, 1300 West Park Street, Butte, MT 59701; *Phone:* 406-496-4289; *Fax:* 406-496-4696; *Email:* averlanic@mtech.edu

○ Summer Institute on Atmospheric and Hydrospheric Sciences

http://neptune.gsfc.nasa.gov/~fj2pg/sum_inst.html

NASA's Goddard Space Flight Center (GSFC) convenes an annual summer institute for undergraduate students, which focuses on atmospheric and hydrospheric sciences. The first part of the program is a one-week series of lectures describing proposed areas of research in the basic areas of atmospheric and hydrospheric sciences, and is given primarily by GSFC scientists. Based on these lectures and perceived compatibilities, the students each select their mentor and desired area of research, which is negotiable. The next nine weeks are devoted to an intensive research project with their selected mentor. Students are required to present their results orally at a closing symposium, and in a written report.

The program is directed at undergraduates, majoring in one of the physical sciences, who are in their junior year at the time of application. However, all undergraduates are eligible to apply. No previous experience in atmospheric or hydrospheric sciences is needed.

There is no formal application form for this project. Applications should be submitted in the form of a letter containing the following information: 1) full name; 2) address and phone number at school; 3) permanent address and phone number at which you can always be reached; 4) current grade level; 5) current grade point average; 6) major field; 7) Social Security Number; 8) one-page typewritten statement of your professional goals and interests; 9) description of computer programming and laboratory experience, if any; 10) citizenship; 11) transcripts of any courses and grades; and 12) the names of two faculty members who know your work well and have been asked to provide letter of reference. The transcripts and letters of reference should be sent directly by the university and faculty members to the address below.

The deadline for receipt of applications is in February, with awards announced in March. All applications receive consideration, without regard to race, color, age, national or ethnic origin, or sex.

CONTACT: Per Gloersen, NASA Goddard Space Flight Center, Code 971, Greenbelt, MD 20771; *Phone:* 301-614-5710; *Fax:* 301-614-5644; *Email:* per.gloersen@gsfc.nasa.gov

○ Undergraduate Student Awards for Research (USAR)

NASA, through the Office of Equal Opportunity Programs, Minority University Research and Education Division (MURED), provides funding to a limited number of academic institutions for tuition assistance or fellowships for students who are U. S. citizens enrolled in selected science and engineering courses of study. The program goals include: recruitment, retention, and development of students at the beginning of their undergraduate studies to career paths in areas of science or engineering relevant to NASA's missions. This need-based program provides up to 50% (75% for student's eligible for the Pell Grant), but not more than $7,000, to defray educational costs. The award also provides $4,000 for a required summer research experience. Participating universities can be found on the NASA MURED Website.

CONTACT: Visit **http://mured.nasaprs.com** and click on ***Awards–3rd Party Awards–USAR***; or *Phone:* 202-358-1347.

○ Visiting Student Enrichment Program

http://esdcd.gsfc.nasa.gov/VSEP

The **Visiting Student Enrichment Program (VSEP)** offers students summer employment with the Goddard Earth Sciences and Technology Center (GEST), working with NASA/Goddard Space Flight Center's (GSFC) scientists. Student projects have included simulating neural networks, preparing image analysis algorithms on supercomput-

ers, developing computational science applications, and creating interactive Web sites.

The program is open to full-time students in computer science, the physical sciences, and mathematics. Participants must be either U.S. citizens or foreign nationals in U.S. schools who are either permanent residents or who possess a valid F1 work visa. All selected students will be subject to a pre-employment security background check under current security guidelines. Undergraduate and graduate students must have taken courses in physical and computer sciences directly related to their areas of study. High school students will be evaluated with emphasis on their potential and related extracurricular experiences, as well as on course work. The number of positions available for high school students is limited.

In 2002, project experiences are available from June 10 to August 16, 2002 (High school students may start/stop later subject to housing availability), at GSFC in Greenbelt, MD. Students are provided opportunities to work with scientists and professionals at a world-class facility while experiencing meaningful work through a project primarily focused on computer science or the application of computers to solve problems in other sciences. VSEP also offers field trips and lectures to broaden appreciation for GSFC's mission and activities.

The program now encompasses more than seven divisions at GSFC, usually including the following related to the Earth sciences: Laboratory for Atmospheres, the Global Change Data Center, the Laboratory for Hydrospheric Processes, and the Space Data and Computing Division in the Earth Sciences Directorate.

CONTACT: Contact: Marilyn Mack, NASA GSFC, Code 933, Greenbelt, MD 20771; *Phone:* 301-286-4638; *Email:* marilyn.mack@gsfc.nasa.gov

POSTDOCTORATE

○ National Research Council (NRC) Resident Research Associateship (RRA) Programs

http://www.national-academies.org/rap

The **NRC** conducts a national competition to recommend and make awards to outstanding scientists and engineers at recent postdoctoral and experienced senior levels for tenure as guest researchers at participating NASA laboratories. Recent postdoctoral graduates are provided with an opportunity for concentrated research in association with selected members of the permanent professional laboratory staff, often as a climax to formal career preparation. Recent doctoral recipients as well as experienced Ph.D. scientists and engineers are afforded an opportunity for research without the interruptions and distractions of permanent career positions. National Research Council administers the **RRA** program.

This program is open to all Ph.D.s, or equivalent, in science and engineering disciplines relevant to NASA research programs, including NASA's Earth Science Enterprise. As many as 200 NRC-NASA Associates are on tenure annually across all NASA Strategic Enterprises and Field Centers. All opportunities for research at NASA Centers are open to U.S. citizens and U.S. legal permanent residents; many of the opportunities are also open to other non-U.S. citizens.

Applicants must submit a research proposal that responds to a specific research opportunity at the desired NASA Center. These research opportunities are published annually in brochures for each Center and on the Internet at **www.national-academies.org/rap**. Awardees must hold a Ph.D., Sc.D., or other earned research doctoral degree recognized in U.S. academic circles as equivalent to the Ph.D., or must submit acceptable evidence of completion of all formal academic requirements for one of these degrees before tenure may begin. Applications, submitted directly to the NRC, are accepted on a continuous basis. The following is the general schedule for this program:

- ☐ ***Applications postmarked by: April 15— Will be reviewed in: late June***
- ☐ ***Applications postmarked by: August 15— Will be reviewed in: late October***
- ☐ ***Applications postmarked by: January 15— Will be reviewed in: late February***

CONTACT: National Research Council, Associateship Programs–TJ 2114, 2101 Constitution Avenue, NW, Washington, DC 20418; *Fax:* 202-334-2759.

Teacher preparation and enhancement activities are a key part of NASA's Earth Science Enterprise Education Program. These programs provide an opportunity for Earth system science to be included as part of a teacher's degree program or certification, as well as in-service, continuing education activities and programs that update skills, enrich, and strengthen the theoretical and practical basis for classroom and laboratory instruction. Programs include workshops, courses, internships, and other activities that encourage incorporating Earth system science content into existing courses and curriculum related to science, mathematics, engineering, and technology.

NASA also sponsors programs designed for college and university faculty, to enrich their scientific and technical expertise and help them to establish NASA research contacts. These programs include workshops and working experiences at NASA Centers.

ELEMENTARY & SECONDARY

○ Access Earth

http://accessearth.usm.maine.edu

Access Earth is a program for high school students with disabilities and teachers to encourage students with disabilities to enter careers in Earth system science. Students and teachers attend an intensive week-long summer institute focusing on land-ocean-atmosphere interactions, with field activities based at the Wells National Estuarine Research Reserve on the coast of Maine. Topics to be covered include climate change and sea level rise, land use changes, atmospheric pollution, and coastal watershed management. Participating teachers will work with scientists, educators, and students with disabilities to develop, test, and refine accessible Earth system science curriculum. Students will work with scientists, collecting and analyzing scientific data, and will learn about career opportunities in Earth system science.

The 2002 institute will be offered from July 19 through July 26, for high school science teachers and from July 21 through July 26, for high school students with disabilities. The program is limited each year to 10 teachers and 15 students from Maine, New Hampshire, and Vermont. High school teachers of Earth science, general science, or environmental science are especially encouraged to apply, but applications will be accepted from other disciplines. Students should be entering ninth or tenth grade. Participating teachers are expected to further test and refine curriculum in their classrooms during the school year. Course materials and room and board are provided. Teacher participants also receive a $500 stipend upon successful completion of the institute.

CONTACT: Nancy Lightbody, College of Education and Human Development, University of Southern Maine, 301C Bailey Hall, Gorham, ME 04038; *Phone:* 207-228-8115; *Fax:* 207-780-5224; *Email:* nancy@lightbody.org

○ Alaska Alliance for Earth System Science Education

The objectives of the **Alaska Alliance** are twofold: 1) to increase public understanding of global climate variability and its relevance to Alaskan communities; and 2) to strengthen teaching and learning of related subjects in the K–16 classrooms. To accomplish its objectives the project is:

- ☐ adapting appropriate science and technology content and education materials that have already been developed and tested (e.g., NASA Earth science education resources);
- ☐ improving systemic efforts by linking existing programs with Earth and environmental education institutions; and
- ☐ augmenting existing capabilities to enable these programs to increase their scope and reach, particularly within rural Alaska.

The Alaska Alliance includes the participation of the following organizations: The Global Learning and Observations to Benefit the Environment (GLOBE) partners and

schools; The Alaska Space Grant Program; Kachemak Bay National Estuarine Research Reserve (KBNERR); and Challenger Learning Center of Alaska.

CONTACT: Elena Sparrow, Associate Professor and Alaska GLOBE Partner Coordinator, 317 O'Neill Bldg., PO Box 757200, SALRM, University of Alaska Fairbanks, Fairbanks, Alaska 99775-7200; *Phone:* 907-474-7699; *Email:* ffebs@aurora.uaf.edu

○ Certificate and Master's Degree Program in Earth/Space Science for Elementary/Secondary Teachers

http://henry.pha.jhu.edu/ssip/index.html

The Maryland Space Grant Consortium, in collaboration with The John Hopkins Graduate Division of Education, offers a three-phase **Earth/Space Science** Internship Program (ESSIP) that provides nine graduate credits that may be used toward: 1) a graduate certificate in Earth/Space Science; or 2) a Hopkins Masters of Science in Teacher Development and Leadership with a specialization in earth/space science.

ESSIP includes three Johns Hopkins courses—"Understanding and Teaching the Solar System" (PHASE I), "Understanding and Teaching Earth Observation from Space" (PHASE II), and an eight-week research internship (PHASE III). This graduate degree program for in-service teachers fosters collaboration among The Johns Hopkins Graduate Division of Education, NASA Goddard Space Flight Center Education Programs Office, the Maryland State Department of Education, and affiliates of Maryland Space Grant Consortium.

SSIP promotes course content from NASA's Earth Science Enterprise to promote the Maryland School Performance and Assessment Program core learning goals for science, the American Association for the Advancement of Science K–12 Benchmarks for Science Library, and the National Academy of Sciences' K–12 Standards.

Who May Apply: Elementary, middle or high school mathematics, science, physics, environmental science, social studies, or geography teachers from public or private schools may apply to the program.

An MSGC Funding Assistance Scholarship provides funding for half of the current Hopkins tuition and registration fee for teachers taking the ESSIP courses. MSGC scholarship funding is also provided for a third of the current Hopkins tuition and registration fee for teachers taking courses other than the ESSIP courses in the Graduate Certificate Program in Earth/Space Science and in the Master of Science in Teacher Development and Leadership with specialization in Earth/space science.

CONTACT: Anne Anikis, Assistant Director, Maryland Space Grant Consortium, The Johns Hopkins University, Bloomberg Center for Physics and Astronomy, Room 203, 3400 N. Charles Street, Baltimore, MD 21218-2686; *Phone:* 410-516-7106; *Fax:* 410-516-4109; *Email:* anne@pha.jhu.edu

○ The Dynamic Earth

http://www.discoverycube.org

Discovery Science Center is an interactive science center with over 100 hands-on exhibits augmented by educational programming and materials providing learning opportunities for students, teachers, and family audiences. **The Dynamic Earth** program includes:

- ☐ Resource materials and kits provide the classroom teachers with a set of hands-on materials that will enable the students to design and test experiments. The curriculum packet contains science content information, vocabulary list, a materials list, timeline for preparation and implementation, tips for managing the students or classroom during hands-on experiences, a bibliography of additional materials, and a collection of professional contacts.
- ☐ Teacher training program in the use of these materials and lesson plans. This six-hour training, along with the teacher's guide and kit, will enable two to three weeks of classroom instruction.
- ☐ An interactive science presentation for the classroom or general public.
- ☐ Family science nights at the science center. These evenings will introduce families to the science programs presented in the schools. Families will observe science demonstrations, attend science lectures, interact with the hands-on exhibitry, such as an earthquake simulation room, an eight-foot free-standing tornado, and a kalliroscope that models the fluid dynamics of the ocean and/or the atmosphere.

Some of the concepts that Dynamic Earth participants will investigate are:

- ☐ Plate tectonics and the changing patterns of land, sea, and mountains on the Earth's surface;
- ☐ How the sun's heating of the Earth's surface drives convection within the atmosphere and oceans, producing winds and ocean currents, leading to an understanding of global weather patterns and

geographical distribution of marine and terrestrial organisms; and

- ☐ Human impact on the Earth's atmosphere, and in turn how the altered atmospheric conditions affect all life on Earth.

Interested parties should contact the Education Department or Group Bookings at 714-542-2823.

CONTACT: Janet Yamaguchi, Vice President, Education, Discovery Science Center, 2500 North Main Street, Santa Ana, CA 92705; *Phone:* 714-542-2823; *Fax:* 714-542-2828; *Email:* jyamaguchi@discoverycube.org

○ Earth Science Component for Academic Professional Enhancement (ESCAPE)

http://tellus.ssec.wisc.edu/outreach/ESCAPE/esc.html

This course addresses the professional development needs of upper elementary, middle, and high school science teachers in Wisconsin and neighboring states by offering NASA's Classroom of the Future online Earth system science course in conjunction with the GET-WISE project. **ESCAPE** investigates deforestation, volcanoes, hurricanes, and ice shelf disintegration. GET-WISE currently features two lecture series, one in Earth System Science and another focusing on the Solar System.

Two graduate level credits are available through the University of Wisconsin-Madison, Department of Atmospheric and Oceanic Science, upon successful completion of the ESCAPE course.

CONTACT: Margaret Mooney, Office of Space Science Education–Space Science & Engineering Center, University of Wisconsin-Madison, 1225 W. Dayton Street, Madison, WI 53706; *Email:* mooney@ssec.wisc.edu

○ Earth Science Enterprise Research Program—University of Montana

www.umt.edu/ccesp/ese.htm

The **University of Montana** (UM) provides a technology learning center for professional teacher training and teacher in-service, which brings remote-sensing and basic Geographic Information System (GIS) applications into the classroom. Using data products provided by UM's Numerical Terradynamic Simulation Group (NTSG) and supplementing ongoing educational programs, UM's learning center introduces the latest remote-sensing concepts to the next generation of science classrooms in Montana.

UM has developed an online, for-credit, course program for pre-service and in-service education of the teachers of Montana, as well as the technical components to expand this program nationally and internationally. This project brings online Earth system science courses developed by the Center for Educational Technologies at Wheeling Jesuit University into the UM learning environment, presented through the e-College[tm] network.

Additionally, the project plans outreach and study of online courses for the Montana Native American population, working closely with several reservations across Montana. During the first year, the project focused on one reservation and is expanding over the three-year program to integrate operations in state and national hosts. Immediate impact is expected on Montana classrooms, with plans to explore the impact on Native American classrooms where special conditions and constraints may prevail. Project evaluation will delve deeply into the perceived meaning of scientific understandings in the Native American teaching corps and examine how these meanings are communicated in their classrooms.

CONTACT: Wes Snyder, Research Professor of Education, University of Montana, James E. Todd Building, Missoula, Montana 58912; *Email:* Conradwsnyder@aol.com

○ Earth System Science Academy

http://nia.ecsu.edu/nrts/ess/earth.html

The Network Resources and Training Site (NRTS) program is funded by the MU-SPIN Office of Goddard Space Flight Center. The NRTS housed at Elizabeth City State University (ECSU) is designed to serve the states of North Carolina and Virginia. It provides technology training and facilitates network opportunities in research and education for under-represented science/mathematics faculty and students, as well as for teachers of predominately minority-attended elementary and secondary schools in ECSU's region. The research focus for this NRTS includes Earth system science.

The **Earth System Science Academy** is one of the major K–12 Earth system science initiatives sponsored by the ECSU NRTS. During the two-day summer academy, teachers tour the Great Dismal Swamp and actively become involved with water testing techniques. Teachers attend both geoscience and Internet workshops. Internet workshops focus on NASA educational resources on Earth system science. The Earth System Science Academy offers educators the opportunity to learn about the health of local waterways and the Great Dismal Swamp. The Academy challenges educators to develop new skills through the experience of working with university and NASA researchers. Included in the Earth System Science

Academy is a tour of the Great Dismal Swamp Boardwalk; Hands on Water Quality Labs; and workshops on Earth system science.

CONTACT: Dr. Linda Hayden, NASA Network Resources and Training Site, Elizabeth City State University, Box 672, 1704 Weeksville Road, Elizabeth City, NC 27909; *Phone:* 252-335-3696; *Fax:* 252-335- 3790; *Email:* lhayden@umfort.cs.ecsu.edu

○ Earth System Science Education Alliance (ESSEA)

http://www.cet.edu/essea

The **Earth System Science Education Alliance (ESSEA)**, a partnership between the Institute for Global Environmental Strategies (IGES) and the Center for Educational Technologies (CET) at Wheeling Jesuit University, through funding from NASA's Earth Science Enterprise, is an exciting and innovative professional development program.

ESSEA is supporting universities, colleges, and science education organizations in offering K–12 Earth system science (ESS) online graduate courses that have been developed within the CET at Wheeling Jesuit University for NASA's Earth Science Enterprise. The Earth system science courses use an innovative instructional design model, are delivered over the Internet, and feature student-centered, knowledge-building virtual communities. A master teacher and/or an Earth system scientist, who act as guides and mentors throughout the 16-week courses, moderate participants.

The following paragraphs describe the three online courses.

☐ Earth System Science Online Professional Development Course—Elementary Teachers

www2.cet.edu/ete/hilk4/main.html

This three credit-hour graduate course engages primary school teachers in online collaborative activities emphasizing the use of hands-on activities. The goal is to lay an early foundation of ESS knowledge upon which the students can build as they progress through their K–12 experiences. Course participants will build a virtual community with teachers from around the world; work with their students in hands-on terrarium activities; design an ESS unit encompassing land, air, water, and living things; and maintain an online portfolio of activities and group contributions.

☐ Earth System Science Online Professional Development Course—Middle School Teachers

www2.cet.edu/ete/5-8/main.html

This online course for teachers of grades 5 through 8 implements a student-centered Earth system science-based classroom where participants learn from the student's point of view. Teachers participating in this course work in collaborative groups to tackle problems and information that are often completely new to them. Active participation and reflection on learning in student-centered model provides participants opportunities for transfer of learning to their own teaching. Teachers from across the United States analyze the impact of Earth events on spheres (hydrosphere, etc.); develop Earth systems models; experience the "jigsaw" approach to studying the fundamental "spheres" of Earth system science; create ESS activities to use with their students; and use "journals" for individual reflections on those issues concerned with changes or modifications to beliefs about teaching and learning.

☐ Earth System Science Online Professional Development Course—High School Teachers

www2.cet.edu/ete/hil912/main.html

This sixteen-week, graduate course for high school teachers features a collaborative, inquiry-based electronic environment, where teachers from across the United States collaborate in learning teams of four to six teachers; analyze the impact of Earth events on spheres; develop Earth systems models; research Problem Based Learning (PBL); develop a series of online reflections; and create ESS and PBL activities to use with their students and offer feedback to their peers.

CONTACT: The following institutions offer one or more of these Earth system science courses. Unless specified, institutions accept students from any geographic region. Course selection, schedules, and costs will vary; you should contact institutions directly for specific course information. A listing of all the ESSEA courses is available at: **http://www.cet.edu/essea**

For more information, contact: Claudia Dauksys; *Phone:* 703-312-0827; *Email:* essea@strategies.org

California State University at Northridge
http://geology.csun.edu/ESSEA.html
CONTACT: Dr. Gerry Simila, gsimila@csun.edu
**Los Angeles School Districts*

Elizabeth City State University
http://nia.ecsu.edu/nrts.html
CONTACT: Dr. Linda Hayden, lhayden@umfort.cs.ecsu.edu

30

Gulf of Maine Aquarium
http://www.gma.org
CONTACT: Ms. Justine Glynn, justine@gma.org

Kentucky Team:
Morehead State University
CONTACT: Dr. Joan Whitworth, jwhitworth@morehead-st.edu
Western Kentucky University
CONTACT: Dr. Fred Siewers, Fred.Siewers@wku.edu

University of Minnesota/ Concordia University-Saint Paul
CONTACT: Russanne Low, Ph.D., rlow@cce.umn.edu

Louisiana Tech University
CONTACT: Mr. Glenn Beer, gsb006@beta.latech.edu

Hampton University
CONTACT: Dr. Dianne Q. Robinson, Dianne.Robinson@hamptonu.edu

New Mexico State University
CONTACT: Dr. H. Prentice Baptiste, baptiste@mnsu.edu

Texas A&M University–Texarkana
CONTACT: Dr. David Allard, David.Allard@tamut.edu

University of Toledo
CONTACT: Dr. Kevin Czajkowski, kczajko@pop3.utoledo.edu

West Chester University
CONTACT: Rajul Pandya, rpandya@wcupa.edu

WestEd
http://www.wested.org
CONTACT: Ms. Libby Rognier, lrognie@wested.org

Wright State University
http://www.wright.edu
CONTACT: Dr. William Slattery, william.slattery@wright.edu

○ Earth System Science Online Course: An Opportunity in Geography Education

http://www2.una.edu/geography

The goal of this project is to offer K–12 teachers of geography, Earth science, social studies, and other related subjects the opportunity to increase their content knowledge in the field of Earth system science in a convenient, technology-enhanced environment. The objectives are to:

- ☐ increase K–12 teachers' knowledge of, and experience in, Earth system science;
- ☐ provide teachers in underserved areas of Alabama, the southeast, and other areas an opportunity to take a graduate level class in Earth system science;
- ☐ enhance K–12 teachers' use of the Web and source material available;
- ☐ offer pre-service education students the opportunity to increase their content knowledge in Earth system science; and
- ☐ test and demonstrate the Internet as a complete delivery system mechanism for Earth system science instruction.

Admittance to the graduate program at the University of North Alabama is a requirement of participation. The course also focuses on the National Geography Standards.

CONTACT: Dr. William R. Strong, Box 5064 Department of Geography, University of North Alabama, Florence, AL 35632-0001; *Phone:* 256-765-4218; *Fax:* 256-765-4911; *Email:* wstrong@unanov.una.edu

○ The Gaia Crossroads Project

http://www.bigelow.org/~gaia/index.html

The Gaia Crossroads Project is a K–12 education initiative that explores the value of remotely-sensed data as a resource for learning. Since its inception in June 1990, this program has been implemented at all grade levels in more than 94 schools throughout Maine and New Hampshire. This progressive program captures the interest of elementary students and sustains their interest through high school. Using the imagery provided, students are able to study and interpret satellite images of their local communities. After the initial focus on the local environment, the program expands to include images of a broader geographic coverage—the Gulf of Maine and the North Atlantic for studying oceanography, weather satellite images for studying meteorology, and images of tropical rain forests for studying global ecosystems. The project provides ongoing teacher training and technical support.

The philosophy of Gaia Crossroads has been to help students see the connections and balances that exist within local ecosystems and to expand this connectedness to students in the rest of the world. The program is not bound by traditional disciplines taught in school. It draws from all subjects—the sciences, language arts, the social sciences, art, mathematics—to understand and explain what is seen in an image. Likewise, it is not bound by academic achievement, socio-economic background, or gender. It has been the practice that all students be invited to join in the project and to serve their communities with these resources.

The Gaia Crossroads Project: Using Satellite Imagery in the Classroom and Community guidebook for teachers is available through Bigelow Laboratory for Ocean Sciences. This guidebook contains background information on the project, a remote-sensing primer, hands-on tutorials, ideas for setting up the program in a classroom, over sixty activities written and classroom tested by teachers in the Gaia Crossroads Project, and an extensive listing of resources.

CONTACT: Cynthia B. Erickson, Project Director, The Gaia Crossroads Project, Bigelow Laboratory for Ocean Sciences, P.O. Box 475, McKown Point, West Boothbay Harbor, ME 04575-0475; *Phone:* 207-633-9600; *Fax:* 207-633-9641; *Email:* gaiaxroads@bigelow.org

○ Interactions and Diversity: Earth System Science and Beyond

http://ismul.upr.clu.edu
http://web.uprr.pr/prsgc

With demographic trends targeting Hispanics as the fastest-growing and largest minority, it is vital to strengthen efforts to attract them to science-related fields, to help Hispanics reach appropriate representation in the Nation's education base. The Integrated Science Multiuse Laboratory (ISMuL) at the University of Puerto Rico Arecibo Campus, an affiliate of the Puerto Rico Space Grant Consortium, seeks to attract Hispanic students to careers in Science, Mathematics, Engineering, and Technology (SMET) by strengthening the capabilities of their science and mathematics teachers.

ISMuL brought together key local and national experts to develop an experimental educational model responsive to needs in the areas of Earth system science, while helping both P.R. and U.S. teachers to explore together teaching methodologies reflective of the growing ethnic diversity in the Nation. The goal was to promote a better understanding of the idiosyncrasies and cultural aspects that affect the education of under-represented Hispanics by promoting teachers' awareness of cultural and ethnic diversity issues and knowledge of strategies for the productive management of this diversity in the classroom.

As a result, a 10-day summer program will be offered in 2002 on the Earth's interconnections in the tropical environment, focusing on active NASA-sponsored research carried out in the Island. The workshop will focus on the study of distinctive microenvironments in Puerto Rico and the Caribbean and their interactions with life. The underlying questions are: how do land, water, air and life interact to produce the environment on which we live—and to a lesser extent, what is the effect of human activities in these interactions. Science and Math teachers from P.R. and the U.S., particularly from areas that serve significant Hispanic populations, will participate in the program. Participants will develop and pilot test curricular activities for teaching Earth system science, and serve as resources for disseminating Earth system science education among their peers as well as to pre-service teachers.

CONTACT: Ibis L. Aponte-Avellanet, Associate Director, Puerto Rico Space Grant Consortium, Director ISMuL PO Box 23334, San Juan, PR 00931-3334; *Phone:* 787-765-5170, ext. 2117; or 787-764-0000, ext. 5807; *Fax:* 787-756-7717; *Email:* ibis@adam.uprr.pr

○ An Interdisciplinary Professional Development Program for Teachers on Earth System Science Using Information Technology

http://www.pitt.edu/~aap/announce.html

The University of Pittsburgh at Bradford is offering a one-week interdisciplinary workshop on Earth system science aimed at preparing pre-service education students and in-service teachers for the 21st Century. The objective of this interdisciplinary teacher-training course is to develop in students an understanding of the Earth processes shaping the past, present, and future. The course provides hands-on training and experience in applied environmental problem solving through fieldwork, lab practicals, and space-based technology.

Annually, from 2000–2002, the university will solicit a group of 16 motivated, energetic pre-service and in-service science teachers who wish to grow professionally. The program is open at a national level to everyone qualified to apply. The major selection criterion is the potential for integrating the program materials into the participants' instructional activities. Minorities and women are strongly encouraged to apply, as well as those who teach Earth science to communities under-represented in science education. The 2002 workshop will be held July 13–19.

Teachers who are accepted into the program have their tuition and room and board underwritten by the NASA grant and the University of Pittsburgh at Bradford. Successful participants will be awarded one college credit for pre-service or 55 hours of continuing education credit/contact time for in-service participants. Graduate credits

(1–3) are optional and available at the participant's cost.

The scientific team conducting this professional development program consists of seven faculty members from scientifically diverse backgrounds. From Pitt-Bradford come a geology and environmental scientist, a chemist, the director of the Education Program, and a research librarian. The faculty also includes a field biologist from Mercyhurst College, a geographic information systems specialist from Northern Illinois University, and a meteorologist from The Pennsylvania State University.

Deadline to apply for the 2002 workshop is April 1.

CONTACT: Assad Panah, Director, Department of Geology and Environmental Science, University of Pittsburgh at Bradford, 300 Campus Drive, Bradford, PA 16701-2898; *Phone:* 814-362-7569; *Fax:* 814-362-5088; *Email:* aap@pitt.edu

○ ISS EarthKAM

http://www.earthkam.ucsd.edu

Earth Knowledge Acquired by Middle School Students (EarthKAM) engages the educational community in inquiry-based learning to explore and understand planet Earth, using remotely-sensed data from the International Space Station. ISS EarthKAM has accumulated a wealth of images, taken remotely by middle school students operating an electronic still camera flown in Earth orbit. These visible-light images show a diversity of regions and physical features, from every continent except Antarctica—all available on the educational, user-friendly, Web-based data system. Educational materials are also available online to help educators get started with the program and integrate working with images into their classrooms and curricula. EarthKAM's main objectives are to:

- ☐ facilitate collaborative, inquiry-based explorations that utilize Earth images in support of national, state, and local education standards, and
- ☐ provide technology-supported learning opportunities in science, geography, and mathematics.

Middle school educators (grades 5–8) also have the opportunity to join the EarthKAM Community; a registration form is available online. The EarthKAM Community provides additional information and support for students and educators as they explore the Earth images and take their own images from the International Space Station.

ISS EarthKAM is a collaboration among NASA; the University of California, San Diego; Texas A&M; and TERC's Center for Earth and Space Science Education.

CONTACT: EarthKAM Coordinator, TERC, 2067 Massachusetts Ave, Cambridge, MA 02140; *Phone:* 617-547-0430; *Fax:* 617-349-3535; *Email:* EarthKAM_Coordinator@TERC.edu

○ NASA Goddard Institute for Space Studies—Institute on Climate and Planets

http://icp.giss.nasa.gov

NASA Goddard Institute for Space Studies' Education Outreach Program is the **Institute on Climate and Planets (ICP)**, involving students and educators from junior high to graduate school in Earth and space science research alongside world-class scientists. ICP is the GISS response to a national challenge to give students a fair start to become productive and responsible citizens in America's workforce and society. More than a program, ICP is a year-round research and education community that represents the country's diversity, including students, educators and researchers from NASA, Columbia University, City University of New York (CUNY), and other area colleges and New York City metro schools. It aims to help teachers connect current research to national science standards and their teaching, to give students a chance to participate in advanced science learning and workforce preparation, and to work with New York museums on climate literacy.

Through direct research experiences focusing on Earth's climate, ICP seeks to help students develop: 1) views of a world that is connected regionally and globally; 2) problem-solving skill; and 3) science understandings about the Earth system that consider science, technology, and society. A different kind of learning and research lab is evolving in the ICP where students and educators work on-site or remotely with scientists to create new knowledge that may help us better understand and predict Earth's climate. After-school research internships are available at GISS and cooperating universities. In-school, ICP faculty involves students in new or enhanced curriculum to develop climate and space science literacy. Full-time summer enrichment programs offer a more intensive research experience. In-service and pre-service teacher workshops are also conducted to share curriculum.

Several ICP spin-off programs are now available as a result of ICP faculty-scientist collaborations. These include: 1) CUNY-wide training programs to address the scientific digital divide via the University's NASA MUSPIN/NRTS; 2) research programs via the NASA New York City Space Alliance led by Medgar Evers College and the NASA Partnership for Integrating Research;

3) outdoor science education via a carbon field study in New York's Black Rock Forest; and 4) New York metro area intensive observation periods for schools to contribute to climate and health studies conducted through the GISS Urban Measurement of Aerosol and Asthma Program.

CONTACT: Carolyn A. Harris, ICP Director, GISS at Columbia University, 2880 Broadway at 112th Street, New York, NY 10025; *Phone:* 212-678-5653; *Fax:* 212-678-5552; *Email:* charris@giss.nasa.gov

○ PIPELINES

www.phys.subr.edu/pipelines

The **Program to Increase the Pursuit of Education and Learning IN Engineering and Science (PIPELINES)** is a partnership between Southern University and A&M College (SUBR) in Baton Rouge and Iowa State University (ISU). PIPELINES supports activities in Earth and environmental science for students and teachers in K–12, undergraduates, graduates and university faculty. Major components of the program are:

☐ ***Educational reform and support for standards-based curriculum, teaching, and learning***—Both SUBR and ISU offer in-service workshops designed to promote and support standards-based education, with emphasis on science and mathematics education in general and Earth and environmental science education in particular. These workshops are for pre-college teachers and college faculty. Additionally, the SUBR College of Education's Curriculum Center serves as a statewide repository for instructional materials and supplies for teachers in science and mathematics. The center holds regular workshops to aid teachers in preparing meaningful lessons and activities for students.

☐ ***Global Learning and Observations to Benefit the Environment (GLOBE)***—GLOBE **(http://www.globe.gov)** is a worldwide network of K–12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near their schools and report their data via the Internet. The SUBR-GLOBE Partnership provides GLOBE certification training in the basic GLOBE protocols. Teacher participants receive GLOBE materials and supplies, as well as stipends for after-school, weekend, and holiday sessions.

☐ ***Undergraduate Research Support***— PIPELINES supports twenty high-achieving undergraduate students in science, mathematics, and engineering to conduct Earth science research at NASA Field Centers during the summer or at SUBR or ISU.

☐ ***Earth Science at the Timbuktu Academy (ESTA)*** at SUBR is a six-week residential program that provides intensive academic enrichment designed to enhance the academic achievements of pre-college students (i.e., ACT/SAT). Students are exposed to Earth and environmental science education and research, through GLOBE, and to career opportunities. Future college matriculation in Earth science related fields is a major objective of this activity. The Science Bound Program, at ISU, similarly engages pre-college students in academic enrichment activities.

CONTACT: Dr. Diola Bagayoko, Program Director; *Phone:* 225-771-2370; *Fax:* 225-771-4341; *Email:* bagayoko@aol.com—or: Paulette Baptiste-Johnson, Program Administrator, *Phone:* 225-771-2730; *Fax:* 225-771-4341; *Email:* pbaptistejohnson@aol.com

○ Students' Cloud Observations Online (S'COOL) Project

http://scool.larc.nasa.gov

S'COOL is a component of the Clouds and the Earth's Radiant Energy System (CERES) project of NASA's Earth Science Enterprise. The first CERES instrument was launched in late 1997 to provide global data on clouds. The 2nd and 3rd instruments were launched on the Terra spacecraft in December 1999. S'COOL Project participants make ground truth measurements for the CERES experiment. Ground truth measurements are land-based observations to compare with satellite data for the purpose of improving the satellite results.

Participating classes are asked to make basic weather observations and to record the type and features of clouds in the sky at the time that the satellite passes over their location. Observations are then either entered in an online form, emailed, faxed, or mailed to NASA for entry into an online database. Students have access to their results as well as those from other participating schools. Satellite observations for matching times will also be captured so that CERES scientists can evaluate the results and students can compare their observations to the satellite's.

Participants will receive some instructional materials, satellite overpass times, and information necessary for reporting results. There is no cost to participate.

In addition, a week-long teacher workshop is held each summer at NASA Langley Research Center, allowing participating teachers to obtain an in-depth understanding of the related scientific issues to the S'COOL.

CONTACT: Those interested in participating should send email to:

scool@larc.nasa.gov, or write to: Attn: S'COOL, Mail Stop 420, NASA Langley Research Center, Hampton, Virginia 23681-2199 USA. The following information is requested: name of teacher; name of school and grade/age level (minimum of 3rd grade is suggested); postal and email (if available) address; whether or not the class has Internet access; location (city, state and country, as well as latitude and longitude, if known).

○ The Tropical Center for Earth and Space Studies (TCESS)

http://tcess.uprm.edu

The **TCESS** at the University of Puerto Rico at Mayaguez (UPRM) is a NASA University Research Center (URC)—multidisciplinary research units established at minority institutions to focus on a specific area of NASA interest.

The Center's education component is GLOBE-TEST (Teachers Enhancement in Science and Technology)—a comprehensive project to align science, environmental education, and technology with current state educational reforms. The initiative will integrate sensors, calculator-based laboratory (CBL) technology, and geographic information systems (GIS) techniques, as well as the GLOBE (Global Learning and Observations to Benefit the Environment, **http://www.globe.gov**) protocols to current laboratory and curriculum in chemistry, biology, and mathematics. The overall goal of the GLOBE-TEST project is, by the year 2005, to transform a significant number of in-service and pre-service teachers into proficient educators in the areas of science and technology.

The project has designed a professional development program that combines workshops, Saturday academies, follow-up activities, and visits to schools as well as activities for teacher, faculty, parent, and student involvement. Intensive weeklong workshops and Saturday academies will provide teachers the opportunity to become skilled in the TEST activities through hands-on experiences. Follow-up activities will bring the teachers and their students to the TEST facilities at the University to integrate the science knowledge that is part of their K–12 curriculum and the TEST experiences. In-site visits to the schools will then reinforce the teacher's project role. Overall, in five years, the GLOBE TEST project will influence more than two hundred Hispanic teachers and more than six thousand Hispanic students.

CONTACT: Rafael Fernández-Sein, Director, Tropical Center for Earth and Space Studies (TCESS), University of Puerto Rico–Mayagüez; *Email:* rafael@ece.uprm.edu

○ University of Montana's Earth Observing System (EOS) Education Project

http://www.eoscenter.com

This project disseminates EOS mission imagery, supportive curriculum, and relevant programs to the K–16 education community. The EOS Education Project also provides training for the K–16 educational community in the interpretation, utilization, and relevancy of EOS mission imagery. These resources are delivered through a dynamic combination of online and onsite teacher workshops, Internet-based courses, national conferences, interactive map and image servers, and Earth system science content.

Distributed and classroom-based Geographic Information Systems (GIS) are used to assist teachers to obtain remote-sensing imagery and ancillary data for project-based learning. The project investigates how EOS information can enhance existing NASA interdisciplinary curriculums that explore the diverse and changing landscapes of the world.

The EOS Education Project has assembled a team of education, technology, and resource specialists to serve the growing needs of the global environmental education community. The project has also established strategic alliances within the private and public sectors to advance state-of-the-art solutions for geographical information dissemination and education program development across local, regional, and global scales. The collective mission supports educator and student understanding of complex global ecosystems and humans' role in affecting these systems.

CONTACT: *Phone:* 1-800-0411-0341; *Email:* umtonline@selway.umt.edu

POSTSECONDARY

Chautauqua Short Course—How We Study the Earth and Oceans from Space

http://www.chautauqua.pitt.edu

The National Science Foundation-sponsored **Chautauqua Short Courses** are an annual series of forums in which scholars at the frontiers of various sciences meet intensively for several days with undergraduate science teachers. The series is held at colleges and universities throughout the United States as well as at selected special sites. These forums provide an opportunity for invited scholars to communicate new knowledge, concepts, and techniques directly to college teachers in ways that are immediately beneficial to their teaching. The primary aim is to enable undergraduate teachers in the sciences to keep their teaching current with respect to both content and pedagogy.

NASA Jet Propulsion Laboratory is the California Field Center for the Chautauqua Short Courses. Included in the JPL short courses is "How We Study the Earth and Oceans from Space," which will be held August 21–23, 2002, in Pasedena, CA. This course will cover the various missions, technologies and sensors that are currently being used to observe our land, oceans and atmosphere in different wavelengths, the use of radar to allow us to better observe land and ocean, and new technologies that lie in the future. The course will also focus on how the massive amounts of data generated by these missions are handled and understood.

CONTACT: Contact: Gilbert Yanow, NASA Jet Propulsion Laboratory, Mail Stop 264-370, 4800 Oak Grove Dr., Pasadena, CA 91109; *Phone:* 818-354-8060, *Fax:* 818-393-1392; *Email:* gilbert.yanow@jpl.nasa.gov

NASA Faculty Fellowship Program

http://www.asee.org/nffp

The **NASA Faculty Fellowship Program (NFF)** offers science and engineering faculty hands-on exposure to NASA's research challenges through 10-week summer research residencies and extended research opportunities at participating NASA research centers, working closely with NASA colleagues on challenges important to NASA's strategic enterprises, including NASA's Earth Science Enterprise.

The primary objectives of the NASA Faculty Fellowship Program are to increase the quality and quantity of research collaborations between NASA and the academic community that contribute to NASA's research objectives, and to provide research opportunities for college and university faculty that serve to enrich their knowledge base. The program is designed for U.S. citizens with teaching or research appointments at U.S. universities or colleges, preferably with a minimum of two years experience. College and university faculty participants in the FFP can expect a rewarding personal as well as enriching professional experience.

Participants will receive a stipend and relocation allowance for those who must relocate their residence. Approximately 150 first-year fellowships will be awarded. Applicants should be aware that no leave will be granted during the short ten-week tenure and that fellows are required to conduct their research on-site. Faculty participants will be required to submit a research report and provide program evaluation data at the end of the summer period. Extended research opportunities may be available for some faculty participants to continue research on-campus during the academic year. The NFF Program is managed by the American Society for Engineering Education (ASEE) in conjunction with the Universities Space Research Association (USRA).

The application deadline for the 2002 program is February 15.

CONTACT: Justin Stevens, American Society for Engineering Education (ASEE), 1818 N Street, NW, Suite 600; Washington, DC 20036; *Phone:* 202-331-3509; *Email:* j.stevens@asee.org

NASA Goddard Institute for Space Studies—Institute on Climate and Planets

http://icp.giss.nasa.gov

NASA Goddard Institute for Space Studies' Education Outreach Program is the **Institute on Climate and Planets (ICP)**, involving students and educators from junior high to graduate school in Earth and space science research alongside world-class scientists. ICP is the GISS response to a national challenge to give students a fair start to become productive and responsible citizens in America's workforce and society. More than a program, ICP is a year-round research and education community that represents the country's diversity, including students, educators and researchers from NASA, Columbia University, City University of New York (CUNY) and other area colleges and New York City metro schools. It aims to help teachers connect current research to national science standards and their teaching, to give students a chance to participate in advanced science learning and

workforce preparation, and to work with New York museums on climate literacy.

Through direct research experiences focusing on Earth's climate, ICP seeks to help students develop: 1) views of a world that is connected regionally and globally; 2) problem-solving skills; and 3) science understandings about the Earth system that consider science, technology, and society. A different kind of learning and research lab is evolving in the ICP where students and educators work on-site or remotely with scientists to create new knowledge that may help us better understand and predict Earth's climate. After-school research internships are available at GISS and cooperating universities. In-school, ICP faculty involves students in new or enhanced curriculum to develop climate and space science literacy. Full-time summer enrichment programs offer a more intensive research experience. In-service and pre-service teacher workshops are also conducted to share curriculum.

Several ICP spin-off programs are now available as a result of ICP faculty-scientist collaborations. These include: 1) CUNY-wide training programs to address the scientific digital divide via the University's NASA Minority University-SPace Interdisciplinary Network (MU-SPIN)/Network Resources and Training Site (NRTS); 2) research programs via the NASA New York City Space Alliance led by Medgar Evers College and the NASA Partnership for Integrating Research; 3) outdoor science education via a carbon field study in New York's Black Rock Forest; and 4) New York metro area intensive observation periods for schools to contribute to climate and health studies conducted through the GISS Urban Measurement of Aerosol and Asthma Program.

CONTACT: Carolyn A. Harris, ICP Director, GISS at Columbia University, 2880 Broadway at 112th Street, New York, NY 10025; *Phone:* 212-678-5653; *Fax:* 212-678-5552; *Email:* charris@giss.nasa.gov

○ NOVA

http://education.nasa.gov/nova

NASA Opportunities for Visionary Academics (NOVA) was created to develop and disseminate a national framework for enhancing science, mathematics, and technology literacy for teachers in the 21st century. The NOVA consortium, with the University of Alabama, Fayetteville State University, and the University of Idaho as lead institutions, is working to produce enhanced science, mathematics and technology literacy for new teachers. This effort is accomplished through demonstrating an undergraduate science/math/technology course framework, examples of successful course models, and a mentoring support system for faculty wishing to implement new courses or modify existing courses at their universities. The framework uses interactive learning and integrates science, mathematics, and technology as a means of developing a new paradigm for educating teachers. NOVA invites the participation of science, mathematics, engineering, technology, and education faculty who are concerned with how universities prepare new teachers. Using the NASA mission, facilities, and resources, NOVA provides faculty with enhanced knowledge and skills to implement change in university courses. The NOVA team presents its framework for change primarily through three-day workshops to interdisciplinary university teams. These universities are then eligible to submit proposals for Implementation Planning Grants (up to $30,000 for a one-year period) to initiate change in science, mathematics, or engineering courses for preparing K–12 teachers. In addition, the project links participants together through the NOVA Network, which provides the means for faculty and students to exchange and have access to the model, materials, activities, and updated information.

The schedule of workshops and application information is available at **http://education.nasa.gov/nova**. Each participating university or college must identify an interdisciplinary faculty team for the workshop. One team member must be a faculty member in the College of Education. A second team member must be a faculty member in science, mathematics, engineering, or technology. The third team member should be a university or college administrator (e.g., provost, dean, or department head). Applying teams must have access to interactive technologies and the Internet for classroom use. A memorandum of understanding signed by the deans of each college or division participating in the project must be submitted to demonstrate a university-wide commitment.

CONTACT: L. Michael Freeman, Aerospace Engineering & Mechanics, University of Alabama, Box 870280, Tuscaloosa, AL 35487-0280; *Phone:* 205-348-7304; *Fax:* 205-348-4171; *Email:* nova@coe.eng.ua.edu, or mike.freeman@ua.edu

○ PIPELINES

www.phys.subr.edu/pipelines

The Program to Increase the Pursuit of Education and Learning IN Engineering and Science (PIPELINES) is a partnership between Southern University and A&M College (SUBR) in Baton Rouge and Iowa State University (ISU). PIPELINES supports

activities in Earth and environmental science for students and teachers in K–12, undergraduates, graduates, and university faculty. Major components of the program are:

☐ ***Educational reform and support for standards-based curriculum, teaching, and learning***—Both SUBR and ISU offer in-service workshops designed to promote and support standards-based education, with emphasis on science and mathematics education in general and Earth and environmental science education in particular. These workshops are for pre-college teachers and college faculty. Additionally, the SUBR College of Education's Curriculum Center serves as a statewide repository for instructional materials and supplies for teachers in science and mathematics. The center holds regular workshops to aid teachers in preparing meaningful lessons and activities for students.

☐ ***Global Learning and Observations to Benefit the Environment (GLOBE)***—GLOBE **(http://www.globe.gov)** is a worldwide network of K–12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near their schools and report their data via the Internet. The SUBR-GLOBE Partnership provides GLOBE certification training in the basic GLOBE protocols. Teacher participants receive GLOBE materials and supplies, as well as stipends for after-school, weekend, and holiday sessions.

☐ ***Undergraduate Research Support***—PIPELINES supports twenty high-achieving undergraduate students in science, mathematics, and engineering to conduct Earth science research at NASA Field Centers during the summer or at SUBR or ISU.

☐ ***Earth Science at the Timbuktu Academy (ESTA) at SUBR*** is a six-week residential program that provides intensive academic enrichment designed to enhance the academic achievements of pre-college students (i.e., ACT/SAT). Students are exposed to Earth and environmental science education and research through GLOBE, and to career opportunities. Future college matriculation in Earth Science related fields is a major objective of this activity. The Science Bound Program, at ISU, similarly engages pre-college students in academic enrichment activities.

CONTACT: Dr. Diola Bagayoko, Program Director; *Phone:* 225-771-2370; *Fax:* 225-7714341; *Email:* bagayoko@aol.com—or: Paulette Baptiste-Johnson, Program Administrator; *Phone:* 225-771-2730; *Fax:* 225-771-4341; *Email:* pbaptistejohnson@aol.com

33

Curriculum support includes the development, use, and distribution of science, mathematics, and technology education products and curriculum materials based on the Earth Science Enterprise's unique mission and results. These activities include support for elementary through college-level curricula and focuses on an interdisciplinary approach that supports national education standards. A listing of specific Earth Science Enterprise education products and how to obtain them is included in the Resources section of the catalog. This section provides information on NASA-sponsored curriculum support and dissemination projects.

ELEMENTARY & SECONDARY

○ Access Earth

http://accessearth.usm.maine.edu

Access Earth is a program for high school students with disabilities and teachers to encourage students with disabilities to enter careers in Earth system science. Students and teachers attend an intensive week-long summer institute focusing on land-ocean-atmosphere interactions, with field activities based at the Wells National Estuarine Research Reserve on the coast of Maine. Topics to be covered include climate change and sea level rise, land use changes, atmospheric pollution, and coastal watershed management. Participating teachers will work with scientists, educators, and students with disabilities to develop, test, and refine accessible Earth system science curriculum. Students will work with scientists, collecting and analyzing scientific data, and will learn about career opportunities in Earth system science.

In 2002 the institute will be offered from July 19 through July 26, for high school science teachers and from July 21 through July 26, for high school students with disabilities. The program is limited each year to 10 teachers and 15 students from Maine, New Hampshire, and Vermont. High school teachers of Earth science, general science, or environmental science are especially encouraged to apply, but applications will be accepted from other disciplines. Students should be entering ninth or tenth grade. Participating teachers are expected to further test and refine curriculum in their classrooms during the school year. Course materials and room and board are provided. Teacher participants also receive a $500 stipend upon successful completion of the institute.

CONTACT: Nancy Lightbody, College of Education and Human Development, University of Southern Maine, 301C Bailey Hall, Gorham, ME 04038; *Phone:* 207-228-8115; *Fax:* 207-780-5224; *Email:* nancy@lightbody.org

○ The Dynamic Earth

http://www.discoverycube.org

Discovery Science Center is an interactive science center with over 100 hands-on exhibits augmented by educational programming and materials providing learning opportunities for students, teachers, and family audiences. **The Dynamic Earth** program includes:

- ☐ Resource materials and kits provide the classroom teachers with a set of hands-on materials that will enable the students to design and test experiments. The curriculum packet contains science content information, vocabulary list, a materials list, timeline for preparation and implementation, tips for managing the students or classroom during hands-on experiences, a bibliography of additional materials, and a collection of professional contacts.
- ☐ Teacher training program in the use of these materials and lesson plans. This six-hour training, along with the teacher's guide and kit, will enable two to three weeks of classroom instruction.
- ☐ An interactive science presentation for the classroom or general public.
- ☐ Family science nights at the science center. These evenings will introduce families to the science programs presented in the schools. Families will observe science demonstrations, attend science lectures, and interact with the hands-

on exhibitry, such as an earthquake simulation room, an eight-foot free-standing tornado, and a kalliroscope that models the fluid dynamics of the ocean and/or the atmosphere.

Some of the concepts the participants in The Dynamic Earth program will investigate are:

- ☐ Plate tectonics and the changing patterns of land, sea, and mountains on the Earth's surface;
- ☐ How the sun's heating of the Earth's surface drives convection within the atmosphere and oceans, producing winds and ocean currents, leading to an understanding of global weather patterns and geographical distribution of marine and terrestrial organisms; and
- ☐ Human impact on the Earth's atmosphere, and in turn how the altered atmospheric conditions affect all life on Earth.

Interested parties should contact the Education Department or Group Bookings at 714-542-2823.

CONTACT: Janet Yamaguchi, Vice President, Education, Discovery Science Center, 2500 North Main Street, Santa Ana, CA 92705; *Phone:* 714-542-2823; *Fax:* 714-542-2828; *Email:* jyamaguchi@discoverycube.org.

○ Earth System Science Education Alliance (ESSEA)

http://www.cet.edu/essea

The **Earth System Science Education Alliance (ESSEA)**, a partnership between the Institute for Global Environmental Strategies (IGES) and the Center for Educational Technologies (CET) at Wheeling Jesuit University, through funding from NASA's Earth Science Enterprise, is an exciting and innovative professional development program.

ESSEA is supporting universities, colleges, and science education organizations in offering K–12 Earth system science (ESS) online graduate courses that have been developed within the CET at Wheeling Jesuit University for NASA's Earth Science Enterprise. The Earth system science courses use an innovative instructional design model, are delivered over the Internet, and feature student-centered, knowledge-building virtual communities. A master teacher and/or an Earth system scientist, who act as guides and mentors throughout the 16-week courses, moderate participants.

The following paragraphs describe the three online courses.

☐ Earth System Science Online Professional Development Course—Elementary Teachers

www2.cet.edu/ete/hilk4/main.html

This three credit-hour graduate course engages primary school teachers in online collaborative activities emphasizing the use of hands-on activities. The goal is to lay an early foundation of ESS knowledge upon which the students can build as they progress through their K–12 experiences. Course participants will build a virtual community with teachers from around the world; work with their students in hands-on terrarium activities; design an ESS unit encompassing land, air, water, and living things; and maintain an online portfolio of activities and group contributions.

☐ Earth System Science Online Professional Development Course—Middle School Teachers

www2.cet.edu/ete/5-8/main.html

This online course for teachers of grades 5 through 8 implements a student-centered, Earth system science-based classroom where participants learn from the student's point of view. Teachers participating in this course work in collaborative groups to tackle problems and information that are often completely new to them. Active participation and reflection on learning in a student-centered model provides participants opportunities for transfer of learning to their own teaching. Teachers from across the United States analyze the impact of Earth events on spheres (hydrosphere, etc.); develop Earth systems models; experience the "jigsaw" approach to studying the fundamental "spheres" of Earth system science; create ESS activities to use with their students; and use "journals" for individual reflections on those issues concerned with changes or modifications to beliefs about teaching and learning.

☐ Earth System Science Online Professional Development Course—High School Teachers

www2.cet.edu/ete/hil912/main.html

This sixteen-week, graduate course for high school teachers features a collaborative, inquiry-based electronic environment, where teachers from across the United States: collaborate in learning teams of four to six teachers; analyze the impact of Earth events on spheres; develop Earth systems models; research Problem Based Learning (PBL); develop a series of online reflections; and create ESS and PBL activities to use with their students and offer feedback to their peers.

CONTACT: The following institutions offer one or more of these Earth system science courses. Unless specified, institutions accept students from any geographic region. Course selection, schedules, and costs will vary; you should contact institutions directly for specific course information. A listing of all the ESSEA courses is available at: **http://www.cet.edu/essea**

For more information, contact: Claudia Dauksys; *Phone:* 703-312-0827; *Email:* essea@strategies.org

California State University at Northridge
http://geology.csun.edu/ESSEA.html
CONTACT: Dr. Gerry Simila, gsimila@csun.edu
**Los Angeles School Districts*

Elizabeth City State University
http://nia.ecsu.edu/nrts.html
CONTACT: Dr. Linda Hayden, lhayden@umfort.cs.ecsu.edu

Gulf of Maine Aquarium
http://www.gma.org
CONTACT: Ms. Justine Glynn, justine@gma.org

Kentucky Team:
Morehead State University
CONTACT: Dr. Joan Whitworth, jwhitworth@morehead-st.edu
Western Kentucky University
CONTACT: Dr. Fred Siewers, Fred.Siewers@wku.edu
University of Minnesota/ Concordia University-Saint Paul
CONTACT: Russanne Low, Ph.D., rlow@cce.umn.edu

Louisiana Tech University
CONTACT: Mr. Glenn Beer, gsb0006@beta.latech.edu

Hampton University
CONTACT: Dr. Dianne Q. Robinson, Dianne.Robinson@hamptonu.edu

New Mexico State University
CONTACT: Dr. H. Prentice Baptiste, baptiste@mnsu.edu

Texas A&M University–Texarkana
CONTACT: Dr. David Allard, David.Allard@tamut.edu

University of Toledo
CONTACT: Dr. Kevin Czajkowski, kczajko@pop3.utoledo.edu

West Chester University
CONTACT: Rajul Pandya, rpandya@wcupa.edu

WestEd
http://www.wested.org
CONTACT: Ms. Libby Rognier, lrognie@wested.org

Wright State University
http://www.wright.edu
CONTACT: Dr. William Slattery, william.slattery@wright.edu

○ Earth Systems Connections: An Integrated K-5 Science, Mathematics, and Technology Curriculum

http://www.tandl.vt.edu/esc

This project will develop an integrated Earth system science curriculum program intended for children in K–4 classrooms. At the core of the work are three central objectives:

1. To build upon existing data, technologies and resources (e.g. NASA satellite imagery and programs) in the creation of approximately 50 thematic, integrated, stand-alone activities that are cohesively connected across K-5 grade levels. These activities will reflect national content and process standards for elementary-level mathematics and science education.
2. To develop modules around real-world, scientific, and cultural contexts that resonate with typically disadvantaged and underrepresented populations. Collaborative relationships with pilot schools on a Native American reservation, in rural Appalachia, and in inner city areas are being utilized to make the curriculum applicable to a broad range of learners.
3. To support the curriculum by developing an interactive CD-ROM through which students will enter and access data, observe satellite imagery, and post findings. Forums where students across the country can communicate and exchange data with each other will be provided.

Three themes will be developed to provide the content framework for creating the curricular activity modules, namely: 1) "GreenLinks," in which students learn about the central role of plants in the Earth system; 2) "Global Visions," which introduces basic concepts regarding satellites and remote sensing in the context of Earth system science; and 3) "Migrations del Mundo," in which the phenomenon of animal migration is used to demonstrate interrelationships among the Earth's systems. Many of the cultural connections of the curriculum will come alive through short digital video clips of relevant stories from American peoples of various heritages.

Curriculum modules will revolve around hands-on activities, supported and supplemented by CD-ROM and Internet-based lessons.

Extensive piloting of the curriculum modules will take place throughout the duration of the grant at six school sites (two each in South Dakota, Colorado, and Virginia). The project began in June 2000 and welcomes the opportunity to collaborate with other schools, educators, and researchers.

CONTACT: Lee Vierling, SDSM&T, 501 E. St. Joseph St., Rapid City, SD 57701; *Phone:* 605-394-6855; *Fax:* 605-394-6061; *Email:* Lee.Vierling@sdsmt.edu

○ Enhancement of the Global Systems Science High School Curriculum for the Digital Earth Initiative

Lawrence Hall of Science in Berkeley, CA, Atmospheric and Environmental Research, Inc., and Boston's Museum of Science will digitize and enhance the **Global Systems Science (GSS)** high school curriculum series (nine Student Books with Teacher Guides) for interactive use on the Internet and the **Digital Earth Initiative.** The GSS Student Books, developed during the past ten years at the Lawrence Hall of Science, can be combined in various ways to create an interdisciplinary high school course. In the GSS

approach, students integrate the traditional disciplines to probe the interactions among the atmosphere, ocean, ice, solid Earth, and living organisms that shape Earth's evolution and its future. Students study the traditional disciplines, not as ends in themselves, but as tools for a scientific understanding of Earth as an integrated system. The course draws on a variety of disciplines to illustrate how scientists investigate the ways that human activities interact with Earth systems. The content and pedagogy of the Global Systems Science course reflects the four goals that lie at the heart of the National Science Education Standards:

- ☐ GSS starts with real-world societal issues selected to evoke interest, excitement, and an appreciation of the value of science.
- ☐ Through laboratory activities and discussions, students are given opportunities to investigate and apply the scientific processes and principles that inform each of the issues.
- ☐ Students are encouraged to discuss their changing perspectives as the course proceeds, and to think about how they can affect the outcome in each area of concern through personal decisions.
- ☐ Students are motivated to continue their study of technical fields as they encounter a wide diversity of role models featured in the GSS Student guides.

The nine-part GSS Student Book series will not only be digitized, but will include educational software tools that create organic, living documents connected to pertinent data accessible on the Internet. Science, education, research, technology, and public policies will all be integrated and available for students, public planners, the media, and the general public to explore, analyze, and make decisions.

CONTACT: Alan Gould, University of California, Berkeley; *Email:* agould@uclink4.berkeley.edu.

○ Environmental Education Initiative—Field Museum of Chicago

www.fieldmuseum.org

The **Field Museum's** K–8 environmental education initiative uses a multidisciplinary and multimedia approach to teach students and teachers about the environment. Several components comprise the initiative: 1) the "Underground Adventure" exhibition, which focuses on soil as a vital resource; 2) two traveling outreach vehicles call SAMs (Soil Adventure Mobiles) that bring soil activities to parks and schools in the Chicago region; 3) inquiry-based K–8 education curriculum support materials that examine the Earth system in a social and political context; 4) professional development seminars for teachers; and 5) distance learning programs. Through these programs, the Field Museum is providing students and teachers a variety of ways to learn about the environment and strive to increase their awareness of environmental issues and actions. In addition to engaging in hands-on activities, participants have the opportunity to interact with scientists from The Field Museum and become familiar with people, animals, and plants from different global communities through technology.

CONTACT: Field Museum, Education Department, 1400 S. Lake Shore Drive, Chicago, IL 60605-2496.

○ Event Based Science (EBS) Remote Sensing Activities

http://www.eventbasedscience.com/rs.index.html

Montgomery County, MD, Public Schools' EBS Project is working with NASA Goddard Space Flight Center to enhance **EBS** modules (Flood!, Oil Spill!, Fire!, Volcano!, Blight!, Hurricane!, and Earthquake!) with NASA Earth science data. The EBS enhancements consist of integrated, Web-based activities for middle school students that require the use of remote-sensing data. These activities will be added in print form to EBS titles as they are revised. In addition, a new EBS module on Global Warming will be written.

EBS/Remote-Sensing Activities enable middle school students to use remotely-sensed data—especially products from NASA sensors—as they tackle the real-world problems and tasks found in existing EBS modules. Remotely-sensed data are employed as an integral part of both the presentation of Earth system science concepts, and in the solutions to real-world problems.

These activities emphasize the use of key NASA Earth Observing System (EOS)/Moderate Resolution Imaging Spectroradiometer (MODIS) data products, but also include NASA data from Landsat-7, Enhanced Thematic Mapper Plus (ETM+), and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). Some of the MODIS data products are ideally suited to meet the needs of EBS students and teachers. For example, the MODIS snow-cover, ocean-color, sea-surface-temperature (SST), fire, and land-cover products are amenable for use in activities created for middle school students.

Ep 42

CONTACT: Russell Wright, Montgomery County Public Schools, 850 Hungerford Drive, Rockville, MD 20850; *Email:* Russ_Wright@fc.mcps.k12.md.us

○ Learning Technologies Project

http://education.nasa.gov/ltp

The NASA **Learning Technologies Project (LTP)** uses NASA's inspiring mission, unique facilities, and specialized workforce, along with the best emerging technologies, to promote excellence in America's educational system. LTP funds activities that deliver NASA mission content via the Internet and other technologies to foster reform and restructuring in math, science, computing, engineering, and technical education.

LTP promotes effective use of NASA information and knowledge for education and life-long learning by means of:

- ☐ Education Outreach Centers. NASA LTP Center projects breathe life and immediacy into curricula—incorporating technology to enhance learning and using technological advances to serve educational goals. Among the many NASA Center projects are: the NASA Quest Learning Technologies Channel, which allows a multi-dimensional Web experience incorporating email, chat rooms, audio, video, synchronized graphics; and sometimes NASA Television, which offers participants workshops, lectures, seminars, courses, and exciting live events around the world.
- ☐ Leading Educators to Applications, Research and NASA-related Educational Resources in Science (LEARNERS) Projects. The seven LEARNERS projects launched in late 1999 to enhance K–12 science, mathematics, technology, and geography education through Internet-based products derived from content on NASA's mission. These projects feature topics in Earth science, space science, and aerospace technology.
- ☐ Legacy Projects. Funded by LTP in the past are projects ranging from those emphasizing innovative public use of remote-sensing data, to those using Digital Library Technology, to those with an aeronautics focus in grades K–14.

CONTACT: For LTP: Mark León, NASA Ames Research Center; *Email:* mleon@mail.arc.nasa.gov—for the LEARNERS projects: Susan Hoban, NASA Goddard Space Flight Center; *Email:* susan.hoban@gsfc.nasa.gov

○ Maryland Earth and Space Systems Science Curriculum Project

NASA's Goddard Space Flight Center Education Office is collaborating with two Maryland school systems, Anne Arundel County Public Schools and Montgomery County Public Schools, to develop a new high school **Earth and Space Systems Science Curriculum.** This curriculum will address the National Science Education Standards and Maryland's "Core Learning Goals" **(http://mdk12.org/mspp/high_school/what_will/science/index.html),** which will provide the basis for high school performance tests. The curriculum will use a systems approach and be grounded in current Earth and space system science content.

Two courses are being developed: 1) a course for students in grades nine or ten (with Algebra One as a pre-/co-requisite) and 2) a course for students in grades eleven and twelve (with Algebra Two as a pre-/co-requisite).

The writing team is using information provided by NASA scientists as a basis for the content. The "Five E" format, from Constructivist Learning Theory **(http://www.exploratorium.edu/IFI/resources/constructivistlearning.html)** is providing the model for the curriculum design. Throughout curriculum development, Goddard's scientists have been and will continue to be consulted by the writing team to ensure accuracy of content and that the latest scientific facts, theories, and processes are incorporated into the curriculum. An advisory board will be identified to review the curriculum writing efforts.

Initial implementation of the first level of the course began in September 2000 with revisions to the first course and development of the second level course planned during the 2000/2001 school year. Goddard will provide a Web site for curriculum dissemination so that the curriculum will be made available to other school systems.

CONTACT: Mrs. Rochelle Slutskin, AACPS Coordinator of Science, 2644 Riva Rd., Annapolis, MD 21401; *Email:* rtshelli@clark.net—or: Dr. Robert Gabrys, Goddard Space Flight Center, Code 130.3, Greenbelt, MD 20771.

○ Mathematics of the Great Dismal Swamp Project

http://nia.ecsu.edu/nrts/ess/mds/mds.html

The **Mathematics of the Great Dismal Swamp Project** supports a team of professors from Elizabeth City State University (ECSU) to use research on The Great Dismal Swamp Project as a platform for development of mathematics education lessons that incorporate a generic wetlands application. The focus of the project is to improve educators' understanding of

the interdisciplinary nature of Earth system science—including biology, organisms and aquatic levels; chemistry; geoscience, estuaries, and swamp; and math and data analysis. Four new modules will be developed, which include the interdisciplinary approach for incorporating Earth system science in K–12 courses. The lessons developed will be produced on lithographs, postcards, CD-ROM, and posters.

CONTACT: Dr. Linda Bailey Hayden, NASA Network Resources and Training Site, Elizabeth City State University, Box 672, 1704 Weeksville Road, Elizabeth City, NC 27909; *Phone:* 252-335-3696; *Fax:* 252-335-3790; *Email:* lhayden@umfort.cs.ecsu.edu

○ Minority University-SPace Interdisciplinary Network (MU-SPIN)

http://muspin.gsfc.nasa.gov/main/index.html

To help train the next generation of NASA's minority scientists and engineers, NASA's Office of Equal Opportunity Programs created **MU-SPIN** in 1991. The program has remained a highly effective tool as it has continually grown and evolved over the past decade. MU-SPIN serves America's Historically Black Colleges and Universities (HBCUs) and Other Minority Universities (OMUs). OMUs include Hispanic Serving Institutes and Tribal Colleges and Universities.

The first step for the MU-SPIN program was to help provide campuses and schools with network infrastructure. MU-SPIN helped minority schools buy and even build their own computers for the classroom.

In MU-SPIN's next phase, the program established regional hubs to help extend its program to an even larger minority community. To do this, NASA established Network Resources and Training Sites (NRTS). With the NRTS, the program expanded, targeting students from kindergarten through college, faculty, administrators, and community members.

With the infrastructure and regional hubs in place, MU-SPIN established Expert Institutes. These institutes help foster scientific curriculum development and research with the goal of increasing participation in NASA-related science, with a strong emphasis on Earth science.

To further expand its reach, MU-SPIN created the Institutes for Collaborative Research and Education (ICRE) model. This approach facilitates leadership of current partners and encourages involvement of new partners.

CONTACT: James L. Harrington, Jr., MU-SPIN Project Manager, NASA Goddard Space Flight Center, Code 933, Greenbelt, MD 20771; *Phone:* 301-286-4063; *Fax:* 301-286-1775; *Email:* james@muspin.gsfc.nasa.gov

○ NASA Earth Science Missions—Education

Many of NASA's Earth Science Missions have an education and public outreach component. These efforts include a wide variety of educational activities and resources for educators, students, and the public, such as teacher workshops, student activities, and public programs and events, as well as curriculum and classroom materials, and resources such as CD-ROMs, posters, brochures, and videos. Visit the individual Web sites identified below for specific information on their programs and resources, including access to satellite imagery and other data. Missions are listed by year of launch.

□ TOPEX/Poseidon

http://sealevel.jpl.nasa.gov

Jointly sponsored by NASA and the French Space Agency (CNES) the TOPEX/Poseidon satellite has used a radar altimeter to continuously survey ocean surface height since launch in 1992. TOPEX/Poseidon has been joined in orbit by its follow-on mission, Jason-1, which was launched in 2001.

Scientists are using TOPEX/Poseidon and Jason-1 data, accurate to within 4 cm, to learn more about global ocean circulation patterns including phenomena such as the El Niño/La Niña cycle. Oceans are a key mechanism in transporting heat from the Sun around the globe. Researchers are working to improve the understanding of the role of oceans in controlling seasonal variations and longer-term climate changes. Ocean altimetry data are also used for operational purposes including ship routing, fisheries management, hurricane forecasting, and support of underwater activities such as cable laying. **CONTACT:** Annie Richardson, Jet Propulsion Laboratory; topex@jpl.nasa.gov (1992 Launch)

□ SeaWiFS

http://seawifs.gsfc.nasa.gov/SEAWIFS.html

The Sea-viewing Wide Field-of-view Sensor (SeaWiFS) is providing quantitative data on global ocean bio-optical properties. Subtle changes in ocean color signify various types and quantities of marine phytoplankton (microscopic marine plants), the knowledge of which has both scientific and practical applications. (1997 Launch)

☐ Tropical Rainfall Measuring Mission (TRMM)

http://trmm.gsfc.nasa.gov—*click on link for "Educational Resources"*

TRMM is a joint mission between NASA and the National Space Development Agency (NASDA) of Japan. It was designed to monitor and study tropical rainfall and the associated release of energy that helps to power the global atmospheric circulation shaping both weather and climate around the globe. CONTACT: Alan Nelson, Education Coordinator, NASA Tropical Rainfall Measuring Mission (TRMM), Education Department, Science Museum of Minnesota, 120 West Kellogg Boulevard, St. Paul, Minnesota 55102; anelson@smm.org (1997 Launch)

☐ ACRIMSAT

http://www.acrim.com

A series of Active Cavity Radiometer Irradiance Monitors (ACRIMs) provides long-term, precise measurements of the total amount of the Sun's energy that falls on our planet's surface, oceans, and atmosphere. (1999 Launch)

☐ Landsat-7

http://landsat.gsfc.nasa.gov/main/education.html

The Landsat-7 satellite is acquiring remotely-sensed images of land surface and coastal regions for global change research, regional environmental change studies, national security uses, and other civil and commercial purposes. The Landsat-7 data set will provide the first high-resolution view of both seasonal and interannual changes in the terrestrial environment. CONTACT: Stephanie Stockman, NASA Goddard Space Flight Center; stockman@core2.gsfc.nasa.gov (1999 Launch)

☐ QuickScat/SeaWinds

http://winds.jpl.nasa.gov/missions/quikscat/quikindex.html

The SeaWinds instrument on the QuikScat mission is a "quick recovery" mission to fill the gap created by the loss of data from the NASA Scatterometer (NSCAT), when the satellite lost power in June 1997. The SeaWinds instrument is a specialized microwave radar that measures near-surface wind speed and direction under all weather and cloud conditions over the Earth's oceans. (1999 Launch)

☐ Terra

http://terra.nasa.gov

Terra, the flagship of NASA's Earth Observing System, is collecting what will ultimately become a new, 15-year global data set on the state of the land, oceans, and atmosphere. CONTACT: David Herring, NASA Goddard Space Flight Center; dherring@climate.gsfc.nasa.gov (1999 Launch)

☐ EO-1

http://eo1.gsfc.nasa.gov

Earth Observing-1 (EO-1) is the first flight of NASA's New Millennium Program (NMP). Its mission is to validate technologies that will contribute to the reduction in cost of follow-on Landsat missions. (2000 Launch)

☐ Jason-1

http://sealevel.jpl.nasa.gov

The follow-on mission to TOPEX/Poseidon, scientists are using Jason-1 data to learn more about global ocean circulation patterns including phenomena such as the El Niño/La Niña cycle. See TOPEX/Poseidon, 1992 listing on page 36 for additional details. (2001 Launch)

☐ METEOR 3M-1/SAGE III

http://www-sage3.larc.nasa.gov

The SAGE III mission on the Russian Meteor 3M-1 spacecraft seeks to enhance our understanding of natural and human-derived atmospheric processes by providing high latitude long-term measurements of the vertical structure of aerosols, ozone, water vapor, and other important trace gases in the upper troposphere and stratosphere. (2001 Launch)

☐ Aqua

http://aqua.nasa.gov

Aqua, Latin for "water," is named for the large amount of information the mission will be collecting about the Earth's water cycle, including evaporation from the oceans, water vapor in the atmosphere, clouds, precipitation, soil moisture, sea ice, land ice, and snow cover on the land and ice. Additional variables measured by Aqua are radiative energy fluxes, aerosols, vegetation cover on the land, phytoplankton and dissolved organic matter in the oceans, and air, land, and water temperatures. CONTACT: Steve Graham, NASA Goddard Space Flight Center; graham@pop900.gsfc.nasa.gov (2002 Launch)

☐ GRACE

http://essp.gsfc.nasa.gov/grace/index.html

The second of the Pathfinder missions, the Gravity Recovery and Climate Experiment (GRACE) employs a satellite-to-satellite microwave tracking system between two spacecraft to measure the Earth's gravity field and its time variability over five years. Such measurements are directly coupled to long-wavelength ocean circulation processes and to the transport of ocean heat to the Earth's poles. (2002 Launch)

☐ ICESat

http://icesat.gsfc.nasa.gov—*click on link for "Public Outreach"*

The Ice, Cloud, and Land Elevation Satellite (ICESat) is a small satellite mission to fly the Geoscience Laser Altimeter System (GLAS). GLAS will accurately measure the elevation of the Earth's ice sheets, clouds, and land. (2002 Launch)

☐ SORCE

http://lasp.colorado.edu/sorce

The Solar Radiation and Climate Experiment (SORCE) will provide scientists with long-term, accurate measurements of the solar ultraviolet (UV), far ultraviolet (FUV), and total irradiance from the sun. (2002 Launch)

☐ SeaWinds on ADEOS II

http://winds.jpl.nasa.gov/missions/seawinds/seaindex.html

The Advanced Earth Observing Satellite II (ADEOS II), is a joint mission with the National Space Development Agency (NASDA) of Japan. The SeaWinds scatterometer is a specialized microwave radar that measures near-surface wind velocity (both speed and direction) under all weather and cloud conditions over Earth's oceans. (2002 Launch)

☐ Aura

http://aura.gsfc.nasa.gov—*click on link for "Outreach"*

Aura will study the Earth's ozone, air quality and climate. This mission is designed exclusively to conduct research on the composition, chemistry and dynamics of the Earth's upper and lower atmosphere employing multiple instruments on a single satellite. **CONTACT:** Stephanie Stockman, NASA Goddard Space Flight Center; stockman@core2.gsfc.nasa.gov (2003 Launch)

☐ CALIPSO

http://essp.gsfc.nasa.gov/calipso/index.html

CALIPSO (Cloud Aerosol Lidar and Infrared Pathfinder Satellite Observations) will improve our understanding of the role of aerosols and clouds in the processes that govern climate responses and feedbacks and improve the representation of aerosols and clouds in models, leading to more accurate predictions of climate change. It will produce the first 3-dimensional view of aerosols and provide cloud profiles complementary to those of CloudSat. Together, CALIPSO and CloudSat observations of clouds and aerosols can be used to study the affect of aerosols on cloud formation and rain processes. **CONTACT:** Dianne Robinson, Public Outreach Director for CALIPSO, Hampton University; dianne.robinson@hamptonu.edu—or: Barbara Maggi, Public Outreach, Assistant Director for CALIPSO, Hampton University, barbara.maggi@hamptonu.edu (2004 Launch)

☐ CloudSAT

http://cloudsat.atmos.colostate.edu—*click on link for "Outreach"*

CloudSat will provide vertical cloud profiling from space of the full range of clouds from thin cirrus to thick, precipitating convective clouds. It will also provide the first quantitative estimates of ice in clouds. The mission will fill a critical gap in the investigation of feedback mechanisms linking clouds to climate. CloudSat will orbit in formation as part of a constellation of satellites including Aqua, Aura, and CALIPSO. A unique feature that CloudSat brings to this constellation is the ability to fly a precise orbit, enabling the footprint of CloudSat radar to be overlapped with the CALIPSO lidar footprint, as well as the other measurements of the constellation. The precision of this overlap creates a unique multi-satellite observing system for studying the atmospheric processes essential to the hydrological cycle. **CONTACT:** Debra Krumm, Outreach Coordinator, Department of Atmospheric Science, Colorado State University, Fort Collins, CO 80523-1371; *Email:* dkrumm@atmos.colostate.edu (2004 Launch)

☐ GIFTS

http://tellus.ssec.wisc.edu/outreach/gifts/gifts.htm

The Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS) will make revolutionary advances in the weather observations and potentially improve weather forecast skills considerably by making high vertical and horizontal measurements of winds, water vapor, and temperature in the Earth's atmosphere from a geosynchronous altitude (36,000 km above the Earth's surface). **CONTACT:** Arlene Levine, NASA Langley Research Center, a.s.levine@express.larc.nasa.gov (2004 Launch)

○ NASA Goddard Institute for Space Studies—Institute on Climate and Planets

http://icp.giss.nasa.gov

NASA Goddard Institute for Space Studies' Education Outreach Program is the **Institute on Climate and Planets (ICP)**, involving students and educators from junior high to graduate school in Earth and space science research along side world-class scientists. ICP is the GISS response to a national challenge to give students a fair start to become productive and responsible citizens in America's workforce and society. More than a program, ICP is a year-round research and education community that represents the country's diversity, including students, educators and researchers from NASA, Columbia University, City University of New York (CUNY), and other area colleges and New York City metro schools. It aims to help teachers connect current research to national science standards and their teaching, to give students a chance to participate in advanced science learning and workforce preparation, and to work with New York museums on climate literacy.

Through direct research experiences focusing on Earth's climate, ICP seeks to help students develop: 1) views of a world that is connected regionally and globally; 2) problem-solving skills; and 3) science understandings about the Earth system that consider science, technology, and society. A differ-

ent kind of learning and research lab is evolving in the ICP where students and educators work on-site or remotely with scientists to create new knowledge that may help us better understand and predict Earth's climate. After-school research internships are available at GISS and cooperating universities. In-school, ICP faculty involves students in new or enhanced curriculum to develop climate and space science literacy. Full-time summer enrichment programs offer a more intensive research experience. In-service and pre-service teacher workshops are also conducted to share curriculum.

Several ICP spin-off programs are now available as a result of ICP faculty-scientist collaborations. These include: 1) CUNY-wide training programs to address the scientific digital divide via the University's NASA MUSPIN/NRTS; 2) research programs via the NASA New York City Space Alliance led by Medgar Evers College and the NASA Partnership for Integrating Research; 3) outdoor science education via a carbon field study in New York's Black Rock Forest; and 4) New York metro area intensive observation periods for schools to contribute to climate and health studies conducted through the GISS Urban Measurement of Aerosol and Asthma Program.

CONTACT: Carolyn A. Harris, ICP Director, GISS at Columbia University, 2880 Broadway at 112th Street, New York, NY 10025; *Phone:* 212-678-5653; *Fax:* 212-678-5552; *Email:* charris@giss.nasa.gov

NASA Goddard Space Flight Center Earth System Science Education Program (GESSEP)

http://edmall.gsfc.nasa.gov

GESSEP is developing integrated learning technology products for NASA Earth system science education that support both national standards and state curricular frameworks. These learning technologies are delivering a series of middle-high school Earth system science investigations developed by teachers working with scientists from **NASA Goddard Space Flight Center.** The materials are available nationally on the GESSEP Web site for both formal and informal education audiences.

GESSEP will be assessing the effectiveness of these learning technologies once they are implemented in the classroom, as well as how effective they are within different educational environments. The project is also developing a model to understand how the infusion of NASA education materials into an existing or modified instructional package impacts student performance.

CONTACT: Stephen Gilligan, Principal Investigator, 6628 Bucknell Road, Bryans Road, MD 20616; *Phone:* 301-375-8226; *Email:* stephen.gilligan@verizon.net—or: Vern Smith, Co-Investigator, GSFC, Code 130.9, Greenbelt, MD 20771; *Phone:* 301-286-1977; *Email:* vern@aesp.nasa.okstate.gov

The Pigeon Adventure: An Adventure through Remote-Sensing History

The Pigeon Adventure is an interactive Web site and hands-on activities that are being developed to teach children in grades K–4 about remote sensing and change over time. Set in New York City, the product will present science concepts via a pigeon as a metaphor familiar to inner-city children to introduce the concept of perspective and change in urban habitats. Through aerial photography created by pigeon cameras, the product will focus on the benefits of a bird's-eye view then introduce the advances of remote sensing throughout the century.

The interactive adventure will engage children to follow a carrier pigeon on an adventure through New York City. They will be challenged to solve problems based on historical information gathered from the pigeon's adventure and visual cues in the satellite imagery. These problems will emphasize how the city and its habitats have changed over time—thus drawing a systemic relationship of urban development, change-over-time, and its effect on biodiversity.

The materials will enable educators to introduce and reinforce the concepts through hands-on activities linked to national standards. These lessons are designed to enable K–4 students to construct understandings of Earth system science through the use of remote sensing, and aerial and Landsat imagery. The lessons focus on three main interdisciplinary areas: science, social studies, and language arts—and incorporate the four spheres of the Earth system: air (atmosphere), water (hydrosphere), land (geosphere), and life (biosphere). A consistent strand of process skills embedded into each lesson will tie the three areas together though instruction.

CONTACT: Ginger Butcher, NASA Goddard Space Flight Center, Mail Stop 920, Greenbelt, MD 20771; *Phone:* 301-614-6540; *Email:* ginger@ltpmail.gsfc.nasa.gov

Planet Earth Science—Earth System Science Education Courseware

http://www.planearthsci.com

Planet Earth Science is developing a series of four Earth system science education courseware modules that will bring real NASA data and virtual research simulations to the middle-school curriculum. These Earth Data Discovery products will be available through amazon.com and include:

Data Discovery: El Niño, Data Discovery: The Amazon, Data Discovery: Ozone Hole, and *Data Discovery: Global Warming.* All of the products include teacher guides that show how the courseware modules fit national science standards. These software applications are highly interactive and offer a multimedia experience of various Earth system phenomena and data resources. They are compatible with Windows and MacOS computers.

Additional learning modules are under development for undergraduate education in Earth system science. These will employ a new data visualization technology that will allow students to directly manage data resources. These will be available for download by the middle of 2002.

CONTACT: Planet Earth Science, Inc., 30 West Mission St. Suite 8, Santa Barbara, CA 93101.

○ PUMAS (Practical Uses of Math And Science)

http://pumas.jpl.nasa.gov

PUMAS is an online journal of brief examples illustrating how math and science concepts taught in pre-college classes are actually used in everyday life. PUMAS offers a way for researchers to make a substantial contribution to education with a relatively small investment of time and effort.

PUMAS examples may be activities, anecdotes, descriptions of "neat ideas," formal exercises, puzzles, or demonstrations, written primarily by scientists, in any style that serves the material well. They are intended mainly to help K–12 teachers enrich their presentation of science and math in the classroom.

Teachers can search the PUMAS collection based on curriculum topic, grade level, or subject. They can select relevant examples, and develop ideas of their own about how to integrate the material into their lesson plans.

All examples are peer-reviewed by at least one scientist with a relevant background, and at least one teacher at an appropriate grade level. Once accepted, an example is a citable reference in a refereed science education journal, and may be listed in your resume.

Interested in participating? The examples are available to everyone via the PUMAS Web site. The project also needs teachers at all grade levels, scientists, and engineers to volunteer for the pool of PUMAS reviewers. And the project is always looking for good examples of the Practical Uses of Math And Science.

CONTACT: Ralph Kahn, PUMAS editor and founder, Jet Propulsion Laboratory, MS 169-237, 4800 Oak Grove Drive, Pasadena, CA 91109 USA; *Phone:* 818-354-9024; *Fax:* 818-393-4619; *Email:* ralph.kahn@jpl.nasa.gov

○ Regional Earth Science Applications Centers (RESACs)

http://www.esad.ssc.nasa.gov/resac/resacmain.asp

The RESACs are funded by NASA to: 1) apply remote sensing and geospatial technologies to well-defined problems and issues of regional significance; 2) integrate these technologies into the local decision-making process; and 3) support regional assessments associated with the U.S. Global Change Research Program (USGCRP). The seven RESACs each engage in key regional issues, including precision farm management, land cover/use mapping, urban sprawl, fire hazard management, and K–12 education.

☐ ***Northeast Applications of Useable Technology In Land Planning for Urban Sprawl RESAC (NAUTILUS)***
Impacts of urban/suburban growth and land use change on local communities and natural habitats.
http://resac.uconn.edu

☐ ***The Mid-Atlantic RESAC Consortium: Remote Sensing for Resource Management***
Integrated watershed and coastal management (concentrating on the Chesapeake Bay), agricultural and land management information systems, land planning applications, and environmental monitoring.
http://www.geog.umd.edu/resac

☐ ***Integrated Upper Midwest RESAC***
Minnesota, Wisconsin and Michigan
Precision agriculture, forest growth and health, and water and ecosystem resources.
http://resac.gis.umn.edu

☐ ***Northern Great Plains RESAC***
North Dakota, South Dakota, Montana, Wyoming, Idaho, and northwestern Minnesota
Providing soil water estimates to the region's farmers and ranchers and K–12 education.
http://www.umac.org

☐ ***Great Plains RESAC***
Remote-sensing products and technology to support the Great Plains Agrosystem.
http://www.kars.ukans.edu/resac/resac.shtml

☐ ***Integrated Southwest RESAC***
Arizona, New Mexico, California, Colorado, Nevada, and Utah
Application of remote sensing and regional climate modeling to water resource applications such as flood forecasting and snow mapping.
http://resac.hwr.arizona.edu

48

☐ ***Wildlands Fire Hazard RESAC***
Southern California
Managing fire hazards at the urban-wildlands interface.
http://wildfire.geog.csulb.edu/resac/main/netresacmain.htm

○ The Translingual Earth System Science Education Center

http://www.oso.tamucc.edu

As NASA's Earth system science program advances, remarkable innovations in classroom technology promise a wider audience than ever. But in spite of that promise, Earth system science remains a largely English-speaking phenomenon confined to university campuses. The multidisciplinary approaches and integrated tenets of Earth system science are nonexistent in most minority-dominated rural school districts of Texas and the U.S./Mexico borderlands. In the Spanish-speaking countries of Central and South America, a systems approach to Earth Science education is likewise nonexistent.

In a joint international effort led by Texas A&M University-Corpus Christi, online technologies will be coupled with existing teacher cohort networks to deliver trilingual Earth system science content to Hispanic students and educators in Texas, Mexico, Puerto Rico, and selected Latin American countries.

CONTACT: Grady Blount, Texas A&M University-Corpus Christi, Dept. of Physical and Life Sciences, College of Science and Technology, 6300 Ocean Drive, CS 130, Corpus Christi, Texas 78412; *Phone:* 361-825-2358; *Fax:* 361-825-2742.

○ University of Montana's Earth Observing System (EOS) Education Project

http://www.eoscenter.com

This project disseminates EOS mission imagery, supportive curriculum, and relevant programs to the K–16 education community. The **EOS Education Project** also provides training for the K–16 educational community in the interpretation, utilization, and relevancy of EOS mission imagery. These resources are delivered through a dynamic combination of online and onsite teacher workshops, Internet-based courses, national conferences, interactive map and image servers, and Earth system science content.

Distributed and classroom-based Geographic Information Systems (GIS) are used to assist teachers to obtain remote-sensing imagery and ancillary data for project-based learning. The project investigates how EOS information can enhance existing NASA interdisciplinary curriculums that explore the diverse and changing landscapes of the world.

The EOS Education Project has assembled a team of education, technology, and resource specialists to serve the growing needs of the global environmental education community. The project has also established strategic alliances within the private and public sectors to advance state-of-the-art solutions for geographical information dissemination and education program development across local, regional, and global scales. The collective mission supports educator and student understanding of complex global ecosystems and humans' role in affecting these systems.

CONTACT: *Phone:* 1-800-0411-0341; *Email:* umtonline@selway.umt.edu

POSTSECONDARY

○ Curriculum Improvement Partnership Award Program (CIPA)

http://mured.nasaprs.com

The **CIPA Program** provides support to two and four-year minority institutions who have received limited funding from NASA. CIPA is designed to strengthen curricula and technical programs directly related to the NASA mission. The specific objectives are to:

- ☐ increase the quality and quantity of NASA-related science, mathematics, engineering, and technology curricula at nine minority institutions; and
- ☐ increase the number of minority students at the pre-college and college levels that study science, mathematics, engineering, and technology and that choose careers in NASA-related fields.

The 2002 CIPA awardees with an Earth science focus are listed on page 10.

CONTACT: CIPA is a program of NASA's Minority University Research and Education (MURED) program. It is administered by United Negro College Fund Special Programs (UNCFSP). For further information contact Aaron Andrews at 703-205-7640 or visit the UNCFSP Web site at **http://www.uncfsp.org**

○ The Journal of Earth System Science Education (JESSE)

http://jesse.usra.edu

The Journal of Earth System Science Education (JESSE) is a new interdisciplinary electronic journal aiming to foster the study of the Earth as a system while experimenting with the peer review process. JESSE is cre-

ating, implementing, testing and evaluating a peer review process embracing anonymous and open review of educational resources. JESSE aims to optimize the efficiency of the review process and the quality of offerings in advancing the educational agenda of the National Science, Mathematics, Engineering and Technology Digital Library (NSDL) while providing professional recognition for authors and creators of interdisciplinary education resources through publication in a peer reviewed journal.

JESSE is seeking electronic submissions that address understanding the Earth as a system. Authors are encouraged to submit learning resources and modules, courses, texts, articles, research results on Earth system learning and best pedagogical practices, lesson plans, visualization tools, image collections, etc. Authors retain copyright and JESSE maintains an electronic archival copy of all resources published. Guidelines for authors are available on the Web site listed.

CONTACTS: Donald Johnson; *Phone:* 608-262-2538; *Email:* donj@ssec.wisc.edu—or: Martin Ruzek; *Phone:* 920-732-3316; *Email:* ruzek@usra.edu; Universities Space Research Association, 7501 Forbes Blvd, Suite 206, Seabrook, MD 20706.

○ Minority University-SPace Interdisciplinary Network (MU-SPIN)

http://muspin.gsfc.nasa.gov/main/index.html

To help train the next generation of NASA's minority scientists and engineers, NASA's Office of Equal Opportunity Programs created **MU-SPIN** in 1991. The program has remained a highly effective tool as it has continually grown and evolved over the past decade. MU-SPIN serves America's Historically Black Colleges and Universities (HBCUs) and Other Minority Universities (OMUs). OMUs include Hispanic Serving Institutes and Tribal Colleges and Universities.

The first step for the MU-SPIN program was to help provide campuses and schools with network infrastructure. MU-SPIN helped minority schools buy and even build their own computers for the classroom.

In MU-SPIN's next phase, the program established regional hubs to help extend its program to an even larger minority community. To do this, NASA established Network Resources and Training Sites (NRTS). With the NRTS, the program expanded, targeting students from kindergarten through college, faculty, administrators and community members.

With the infrastructure and regional hubs in place, MU-SPIN established Expert Institutes. These institutes help foster scientific curriculum development and research with the goal of increasing participation in NASA-related science, with a strong emphasis on Earth science.

To further expand its reach, MU-SPIN created the Institutes for Collaborative Research and Education (ICRE) model. This approach facilitates leadership of current partners and encourages involvement of new partners.

CONTACT: James L. Harrington, Jr., MU-SPIN Project Manager, NASA Goddard Space Flight Center, Code 933, Greenbelt, MD 20771; *Phone:* 301-286-4063; *Fax:* 301-286-1775; *Email:* james@muspin.gsfc.nasa.gov

○ NOVA

http://education.nasa.gov/nova

NASA Opportunities for Visionary Academics (NOVA) was created to develop and disseminate a national framework for enhancing science, mathematics, and technology literacy for teachers in the 21st century. The NOVA consortium, with the University of Alabama, Fayetteville State University, and the University of Idaho as lead institutions, is working to produce enhanced science, mathematics, and technology literacy for new teachers. This effort is accomplished through demonstrating an undergraduate science/math/technology course framework, examples of successful course models, and a mentoring support system for faculty wishing to implement new courses or modify existing courses at their universities. The framework uses interactive learning and integrates science, mathematics, and technology as a means of developing a new paradigm for educating teachers. NOVA invites the participation of science, mathematics, engineering, technology, and education faculty who are concerned with how universities prepare new teachers. Using the NASA mission, facilities, and resources, NOVA provides faculty with enhanced knowledge and skills to implement change in university courses. The NOVA team presents its framework for change primarily through three-day workshops to interdisciplinary university teams. These universities are then eligible to submit proposals for Implementation Planning Grants (up to $30,000 for a one-year period) to initiate change in science, mathematics, or engineering courses for preparing K–12 teachers. In addition, the project links participants together through the NOVA Network, which provides the means for faculty and students to exchange and have access to the model, materials, activities, and updated information.

The schedule of workshops and application information is available at **http://education.nasa.gov/nova**. Each participating university or college must identify an interdisciplinary faculty team for the workshop. One team member must be a faculty member in

the College of Education. A second team member must be a faculty member in science, mathematics, engineering, or technology. The third team member should be a university or college administrator (e.g., provost, dean, or department head). Applying teams must have access to interactive technologies and the Internet for classroom use. A memorandum of understanding signed by the deans of each college or division participating in the project must be submitted to demonstrate a university-wide commitment.

CONTACT: L. Michael Freeman, Aerospace Engineering & Mechanics, University of Alabama, Box 870280, Tuscaloosa, AL 35487-0280; *Phone:* 205-348-7304; *Fax:* 205-348-4171; *Email:* nova@coe.eng.ua.edu, or: mike.freeman@ua.edu

○ Remote Sensing of Tribal Lands

Salish Kootenai College is providing research experiences in Earth system science to Native American undergraduate students. A new upper-division course **Remote Sensing of Tribal Lands** has been developed within the SKC B.S. in Environmental Science degree program. This course covers the application of remote-sensing technologies to the study of the Earth as a system, and focuses in particular on the place of Montana tribal lands in the Earth system. Fifteen students per year are gaining research experience at an introductory level in this class through completion of a term research project that utilizes remote sensing, geographic information systems, and global positioning system technologies.

Six undergraduate research internships applying remote-sensing data and Earth system modeling to the solution of important environmental problems on tribal lands are also provided each year. These students work under the supervision of SKC researchers. The project Web site publicizes the educational opportunities in Earth system science at Salish Kootenai College, disseminates student research results and NASA Earth Observing System data products covering Native lands, and emphasizes the importance of NASA's Earth Science Enterprise to Native peoples.

CONTACT: Tim Olson, Salish Kootenai College, PO Box 117, Pablo, MT 59855; *Phone:* 406-675-4800, ext. 305; *Fax:* 406-675-4801; *Email:* tim_olson@skc.edu

○ University Based Program in Earth System Science Education (ESSE)

http://www.usra.edu/esse/essonline

The ESSE program consists of faculty from 44 U.S. universities who are linked with one another and with NASA scientists in the development of undergraduate curricula in Earth system science. Managed by the Universities Space Research Association (USRA), the program offers financial incentives to universities that are willing to participate cooperatively with other universities and NASA in interdisciplinary curricula development for Earth system science education. Each university in the program has developed a survey course and senior-level courses in which faculty present Earth system issues as a socially-relevant, challenging, and important class of scientific problems. The objective of the survey-level course is to instill among the general student population an appreciation of the social, economic, and political implications of global change, and a scientific understanding of interrelationships between the Earth's physical and climate system and ecological systems. The objective of the advanced senior-level course is to provide students in the sciences and mathematics with an interdisciplinary perspective of Earth science and global change research. In the senior course, students from different academic departments work in teams to study and develop conceptual and computer models of physical, chemical, and biological processes of the Earth system. The senior course is taught by faculty from at least two relevant academic departments and focuses on scientific issues that draw upon the strengths of the institution. As part of the broader program, universities participate in an organized exchange of scientists and faculty, involving visiting faculty and scientists from other participating universities and from NASA Centers.

CONTACTS: Donald Johnson, *Phone:* 608-262-2538, *Email:* donj@ssec.wisc.edu; Martin Ruzek, *Phone:* 920-732-3316, *Email:* ruzek@usra.edu; Universities Space Research Association, 7501 Forbes Blvd, Suite 206, Seabrook, MD 20706.

Educational technologies include data visualization of complex data sets; distance education through telecommunications and Internet-based courses and research projects; mission simulations; and the design and/or use of instruments, ranging from simple to sophisticated, to collect Earth science measurements. These advanced technologies are used in NASA Earth science education projects across all levels.

ELEMENTARY & SECONDARY

○ Earth Science Component for Academic Professional Enhancement (ESCAPE)

http://tellus.ssec.wisc.edu/outreach/ESCAPE/esc.html

This course addresses the professional development needs of upper elementary, middle and high school science teachers in Wisconsin and neighboring states by offering NASA's Classroom of the Future online Earth system science course in conjunction with the GET-WISE project. **ESCAPE** investigates deforestation, volcanoes, hurricanes and ice shelf disintegration. GET-WISE currently features two lecture series, one in Earth System Science and another focusing on the Solar System.

Two graduate level credits are available through the University of Wisconsin-Madison, Department of Atmospheric and Oceanic Science, upon successful completion of the ESCAPE course.

CONTACT: Margaret Mooney, Office of Space Science Education-Space Science & Engineering Center, University of Wisconsin-Madison, 1225 W. Dayton Street, Madison, WI 53706; *Email:* mooney@ssec.wisc.edu

○ Earth Science Enterprise Research Program–University of Montana

www.umt.edu/ccesp/ese.htm

The **University of Montana (UM)** provides a technology learning center for professional teacher training and teacher in-service, which brings remote-sensing and basic Geographic Information System (GIS) applications into the classroom. Using data products provided by UM's Numerical Terradynamic Simulation Group (NTSG) and supplementing ongoing educational programs, UM's learning center introduces the latest remote-sensing concepts to the next generation of science classrooms in Montana.

UM has developed an online, for credit, course program for pre-service and in-service education of the teachers of Montana, as well as the technical components to expand this program nationally and internationally. This project brings online Earth system science courses developed by the Center for Educational Technologies at Wheeling Jesuit University into the UM learning environment, presented through the e-College[tm] network.

Additionally, the project plans outreach and study of online courses for the Montana Native American population, working closely with several reservations across Montana. During the first year, the project focused on one reservation and is expanding over the three-year program to integrate operations in state and national hosts. Immediate impact is expected on Montana classrooms, with plans to explore the impact on Native American classrooms where special conditions and constraints may prevail. Project evaluation will delve deeply into the perceived meaning of scientific understandings in the Native American teaching corps and examine how these meanings are communicated in their classrooms.

CONTACT: Wes Snyder, Research Professor of Education, University of Montana, James E. Todd Building, Missoula, Montana 58912; *Email:* Conradwsnyder@aol.com

52

Earth System Science Education Alliance (ESSEA)

http://www.cet.edu/essea

The **Earth System Science Education Alliance (ESSEA)**, a partnership between the Institute for Global Environmental Strategies (IGES) and the Center for Educational Technologies (CET) at Wheeling Jesuit University, through funding from NASA's Earth Science Enterprise, is an exciting and innovative professional development program.

ESSEA is supporting universities, colleges, and science education organizations in offering K–12 Earth system science (ESS) online graduate courses that have been developed within the CET at Wheeling Jesuit University for NASA's Earth Science Enterprise. The Earth system science courses use an innovative instructional design model, are delivered over the Internet, and feature student-centered, knowledge-building virtual communities. A master teacher and/or an Earth system scientist, who act as guides and mentors throughout the 16-week courses, moderate participants.

The following paragraphs describe the three online courses.

Earth System Science Online Professional Development Course—Elementary Teachers

www2.cet.edu/ete/hilk4/main.html

This three credit-hour graduate course engages primary school teachers in online collaborative activities emphasizing the use of hands-on activities. The goal is to lay an early foundation of ESS knowledge upon which the students can build as they progress through their K–12 experiences. Course participants will build a virtual community with teachers from around the world; work with their students in hands-on terrarium activities; design an ESS unit encompassing land, air, water, and living things; and maintain an online portfolio of activities and group contributions.

Earth System Science Online Professional Development Course—Middle School Teachers

www2.cet.edu/ete/5-8/main.html

This online course for teachers of grades 5 through 8 implements a student-centered, Earth system science-based classroom where participants learn from the student's point of view. Teachers participating in this course work in collaborative groups to tackle problems and information that are often completely new to them. Active participation and reflection on learning in a student-centered model provides participants opportunities for transfer of learning to their own teaching. Teachers from across the United States analyze the impact of Earth events on spheres (hydrosphere, etc.); develop Earth systems models; experience the "jigsaw" approach to studying the fundamental "spheres" of Earth system science; create ESS activities to use with their students; and use "journals" for individual reflections on those issues concerned with changes or modifications to beliefs about teaching and learning.

Earth System Science Online Professional Development Course—High School Teachers

www2.cet.edu/ete/hil912/main.html

This sixteen-week, graduate course for high school teachers features a collaborative, inquiry-based electronic environment, where teachers from across the United States: collaborate in learning teams of four to six teachers; analyze the impact of Earth events on spheres; develop Earth systems models; research Problem Based Learning (PBL); develop a series of online reflections; and create ESS and PBL activities to use with their students and offer feedback to their peers.

CONTACT: The following institutions offer one or more of these Earth system science courses. Unless specified, institutions accept students from any geographic region. Course selection, schedules, and costs will vary; you should contact institutions directly for specific course information. A listing of all the ESSEA courses is available at: **http://www.cet.edu/essea**

For more information, contact: Claudia Dauksys; *Phone:* 703-312-0827; *Email:* essea@strategies.org

California State University at Northridge
http://geology.csun.edu/ESSEA.html
CONTACT: Dr. Gerry Simila, gsimila@csun.edu
**Los Angeles School Districts*

Elizabeth City State University
http://nia.ecsu.edu/nrts.html
CONTACT: Dr. Linda Hayden, lhayden@umfort.cs.ecsu.edu

Gulf of Maine Aquarium
http://www.gma.org
CONTACT: Ms. Justine Glynn, justine@gma.org

Kentucky Team:
Morehead State University
CONTACT: Dr. Joan Whitworth, jwhitworth@morehead-st.edu
Western Kentucky University
CONTACT: Dr. Fred Siewers, Fred.Siewers@wku.edu

University of Minnesota/ Concordia University-Saint Paul
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○ Enhancement of the Global Systems Science High School Curriculum for the Digital Earth Initiative

Lawrence Hall of Science in Berkeley, CA, Atmospheric and Environmental Research, Inc., and Boston's Museum of Science will digitize and enhance the **Global Systems Science (GSS)** high school curriculum series (nine Student Books with Teacher Guides) for interactive use on the Internet and the Digital Earth Initiative. The GSS Student Books, developed during the past ten years at the Lawrence Hall of Science, can be combined in various ways to create an interdisciplinary high school course. In the GSS approach students integrate the traditional disciplines to probe the interactions among the atmosphere, ocean, ice, solid Earth, and living organisms that shape Earth's evolution and its future. Students study the traditional disciplines, not as ends in themselves, but as tools for a scientific understanding of Earth as an integrated system. The course draws on a variety of disciplines to illustrate how scientists investigate the ways that human activities interact with Earth systems. The content and pedagogy of the Global Systems Science course reflects the four goals that lie at the heart of the National Science Education Standards:

- ☐ GSS starts with real-world societal issues selected to evoke interest, excitement, and an appreciation of the value of science.
- ☐ Through laboratory activities and discussions, students are given opportunities to investigate and apply the scientific processes and principles that inform each of the issues.
- ☐ Students are encouraged to discuss their changing perspectives as the course proceeds, and to think about how they can affect the outcome in each area of concern through personal decisions.
- ☐ Students are motivated to continue their study of technical fields as they encounter a wide diversity of role models featured in the GSS Student guides.

The nine-part GSS Student Book series will not only be digitized, but will include educational software tools that create organic, living documents connected to pertinent data accessible on the Internet. Science, education, research, technology, and public policies will all be integrated and available for students, public planners, the media, and the general public to explore, analyze, and make decisions.

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○ The Gaia Crossroads Project

http://www.bigelow.org/~gaia/index.html

The Gaia Crossroads Project is a K–12 education initiative that explores the value of remotely-sensed data as a resource for learning. Since its inception in June 1990, this program has been implemented at all grade levels in more than 94 schools throughout Maine and New Hampshire. This progressive program captures the interest of elementary students and sustains their interest through high school. Using the imagery provided, students are able to study and interpret satellite images of their local communities. After the initial focus on the local environment, the program expands to include images of a broader geographic coverage-the Gulf of Maine and the North Atlantic for studying oceanography, weather satellite images for studying meteorology, and images of tropical rain forests for studying global ecosystems. The project provides ongoing teacher training and technical support.

The philosophy of Gaia Crossroads has been to help students see the connections and balances that exist within local ecosystems and to expand this connectedness to students in the rest of the world. The program is not bound by traditional disciplines taught in school. It draws from all subjects—the sciences, language arts, the social sciences, art, mathematics—to understand and explain what is seen in an image. Likewise, it is not bound by academic achievement, socio-economic background, or gender. It has been the practice that all students be invited to join in the project and to serve their communities with these resources.

The Gaia Crossroads Project: Using Satellite Imagery in the Classroom and Community guidebook for teachers is available through Bigelow Laboratory for Ocean Sciences. This guidebook contains background information on the project, a remote-sensing primer, hands-on tutorials, ideas for setting up the program in a classroom, over sixty activities written and classroom tested by teachers in the Gaia Crossroads Project, and an extensive listing of resources.

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ISS EarthKAM

http://www.earthkam.ucsd.edu

Earth Knowledge Acquired by Middle School Students (EarthKAM) engages the educational community in inquiry-based learning to explore and understand planet Earth using remotely-sensed data from the International Space Station. ISS EarthKAM has accumulated a wealth of images, taken remotely by middle school students operating an electronic still camera flown in Earth orbit. These visible-light images show a diversity of regions and physical features, from every continent except Antarctica—all available on the educational, user-friendly, Web-based data system. Educational materials are also available online to help educators get started with the program and integrate working with images into their classrooms and curricula. EarthKAM's main objectives are to:

- ☐ facilitate collaborative, inquiry-based explorations that utilize Earth images in support of national, state, and local education standards and
- ☐ provide technology-supported learning opportunities in science, geography, and mathematics.

Middle school educatiors (grades 5–8) also have the opportunity to join the EarthKAM Community; a registration form is available online. The EarthKAM Community provides additional information and support for students and educators as they explore the Earth images and take their own images from the International Space Station.

ISS EarthKAM is a collaboration among NASA; the University of California, San Diego; Texas A&M; and TERC's Center for Earth and Space Science Education.

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The JASON Project

http://www.jasonproject.org

From the depths of the ocean to the heights of the rain forest canopy and from icy polar regions to red-hot volcanoes, **The JASON Project** takes students and teachers on an exciting educational adventure that sparks the imagination of students and enhances the classroom experience. The JASON Project is a multi-disciplinary, educational program that pairs students with leading scientists and experts as they work together to understand the dynamic systems of planet Earth.

Each year, JASON Project staff collaborates with leading scientists, educators, and students to develop year-long curricular materials modeled upon real research. The JASON Project offers a print curriculum filled with research stories, student exercises and masters, assessment tools, teacher preparation, and interdisciplinary links. Engaging video supplements complement this curriculum, highlighting key themes and modeling the work of host researchers. Team JASON Online, the JASON Project's award-winning gated online community, provides additional content, as well as interactivity and community. All of these materials:

- ☐ are fun and engaging,
- ☐ guide teachers and students, through an inquiry based learning experience,
- ☐ emphasize concepts taught in grades 4–9,
- ☐ model national educational standards, and
- ☐ correlate to each state's science, math, social studies, language arts and technology standards.

NASA JASON locations include Ames Research Center, Goddard Space Flight Center, and Johnson Space Center. Programs focus on oceans, rainforests, extreme environments, volcanoes, and exploration of inner and outer space. All programs focus on connecting students and teachers with researchers and scientists in the field.

CONTACT: For more information on how to get involved, visit the JASON on the Web at **www.jasonproject.org** or call 1-888-527-6600.

Learning Technologies Project

http://education.nasa.gov/ltp

The **NASA Learning Technologies Project (LTP)** uses NASA's inspiring mission, unique facilities, and specialized workforce, along with the best emerging technologies, to promote excellence in America's educational

system. LTP funds activities that deliver NASA mission content via the Internet and other technologies to foster reform and restructuring in math, science, computing, engineering, and technical education.

LTP promotes effective use of NASA information and knowledge for education and life-long learning by means of:

- ☐ ***Education Outreach Centers.*** NASA LTP Center projects breathe life and immediacy into curricula—incorporating technology to enhance learning and using technological advances to serve educational goals. Among the many NASA Center projects are the NASA Quest Learning Technologies Channel, which allows a multi-dimensional Web experience incorporating email, chat rooms, audio, video, synchronized graphics; and sometimes NASA Television, which offers participants workshops, lectures, seminars, courses, and exciting live events around the world.
- ☐ ***Leading Educators to Applications, Research and NASA-related Educational Resources in Science (LEARNERS) Projects.*** The seven LEARNERS projects launched in late 1999 to enhance K–12 science, mathematics, technology, and geography education through Internet-based products derived from content on NASA's mission. These projects feature topics in Earth science, space science, and aerospace technology.
- ☐ ***Legacy Projects.*** Funded by LTP in the past are projects ranging from those emphasizing innovative public use of remote-sensing data, to those using Digital Library Technology, to those with an aeronautics focus in grades K–14.

CONTACT: For LTP: Mark León, NASA Ames Research Center; *Email:* mleon@mail.arc.nasa.gov—for the LEARNERS projects: Susan Hoban, NASA Goddard Space Flight Center; *Email:* susan.hoban@gsfc.nasa.gov

○ Minority University-SPace Interdisciplinary Network (MU-SPIN)

http://muspin.gsfc.nasa.gov/main/index.html

To help train the next generation of NASA's minority scientists and engineers, NASA's Office of Equal Opportunity Programs created **MU-SPIN** in 1991. The program has remained a highly effective tool as it has continually grown and evolved over the past decade. MU-SPIN serves America's Historically Black Colleges and Universities (HBCUs), and Other Minority Universities (OMUs). OMUs include Hispanic Serving Institutes and Tribal Colleges and Universities.

The first step for the MU-SPIN program was to help provide campuses and schools with network infrastructure. MU-SPIN helped minority schools buy and even build their own computers for the classroom.

In MU-SPIN's next phase, the program established regional hubs to help extend its program to an even larger minority community. To do this, NASA established Network Resources and Training Sites (NRTS). With the NRTS, the program expanded, targeting students from kindergarten through college, faculty, administrators and community members.

With the infrastructure and regional hubs in place, MU-SPIN established Expert Institutes. These institutes help foster scientific curriculum development and research with the goal of increasing participation in NASA-related science, with a strong emphasis on Earth science.

To further expand its reach, MU-SPIN created the Institutes for Collaborative Research and Education (ICRE) model. This approach facilitates leadership of current partners and encourages involvement of new partners.

CONTACT: James L. Harrington, Jr., MU-SPIN Project Manager, NASA Goddard Space Flight Center, Code 933, Greenbelt, MD 20771; *Phone:* 301-286-4063; *Fax:* 301-286-1775; *Email:* james@muspin.gsfc.nasa.gov

○ Project SUN—Students Understanding Nature

http://sunshine.jpl.nasa.gov

NASA's Genesis Mission currently sponsors **Project SUN** as part of its outreach effort to instill knowledge in students about the natural links between the Earth and Sun. It is also carried out in partnership with the Astronomy and Physics Department and the College of Extended Learning, California State University, Northridge (CSUN). Project SUN is a component of the CSUN International Science Network (ISN).

Through Project SUN, secondary students all over the world are contributing to the long term, time resolved, monitoring of both visible and UV radiation on the Earth's surface. Data is usually transmitted to NASA's Jet Propulsion Laboratory (JPL) via the Internet. Participating schools purchase their own equipment, total cost about $600, not including the cost of a computer supplied by the school to use for the data logger. Schools agree to supply NASA JPL at least two days of data per week for a full school year. The equipment can be used the other three days for individual research projects such as investigating the efficiency of different items of solar energy equipment, use of UV skin blockers, effects of enhanced UV radiation on plants, etc. It is hoped each school

will integrate Project SUN as a continuing program, using the concept of a school research team, just as the school has established athletic teams.

A new aspect of Project SUN will soon be introduced. This adjunct research will be to see if any correlations can be made between changes in the solar wind and observed surface conditions.

The components of Project SUN are: 1) low cost, scientifically accurate instrumentation; 2) computer interfacing coupled with old computers such as the Apple IIE, Apple IIC, Macintosh, and old IBM compatibles used as dedicated data loggers; 3) appropriate software and curriculum; and 4) a detailed operating strategy and a system of inservice teacher training. Part of this training is via the CSUN course Physics 595s, Solar Flux Detection, which is taught over the Internet by Dr. Gilbert Yanow.

Very careful, annual re-calibration of the commercial instruments and a continuing program of instrumentation quality control, done in cooperation with the manufacturers, maintain the accuracy of the data.

CONTACT: Gilbert Yanow, NASA Jet Propulsion Laboratory, Mail Stop 264-370, 4800 Oak Grove Dr., Pasadena, CA 91109; *Phone:* 818-354-8060; *Fax:* 818-393-1392; *Email:* gilbert.yanow@jpl.nasa.gov

○ Student's Online Atmospheric Research (SOLAR): A SAGE III Educational Outreach Program

http://www-sage3.larc.nasa.gov/solar

SOLAR is the outreach component of the Stratospheric Aerosol and Gas Experiment III (SAGE III). SAGE III will provide long-term data on the abundance and global distributions of aerosols, ozone, and other trace gases in the atmosphere, which will enable scientists to assess possible influences of human activities and natural events on the Earth's climate system and other atmospheric processes such as ozone depletion.

SOLAR outreach offers a broad range of science topics related to the Earth's atmosphere, including topics that are especially relevant to science issues addressed by SAGE III. For example, SOLAR highlights some of the major questions regarding the health of the atmosphere, such as possible influences of aerosols on global climate and atmospheric processes related to ozone depletion. SOLAR is geared toward helping teachers bring these topics into the classroom. For example, SOLAR conducts workshops and other special presentations to familiarize science teachers with these and other related topics, and with research being conducted by NASA in these areas. The focus of the workshops is to help teachers integrate these topics into their curriculum and align the topics with learning standards. The SOLAR Web site also presents tutorial discussions on related atmospheric topics.

SOLAR emphasizes involving students in hands-on learning activities. One such activity, selected for middle and high school, helps students develop skills in working with scientific equipment and collecting, analyzing, and reporting scientific data. It involves building a sun photometer, using inexpensive components and instructions supplied by SOLAR. The students, under the guidance of their teacher sponsor, will learn to calibrate and use the instrument to measure optical thickness of the atmosphere. Their data can give a qualitative assessment of the amount of aerosol or haze in the atmosphere. This basic measurement concept is fundamentally very similar to that employed by SAGE III.

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Susan W. Moore, Mail Stop 475, SAIC/NASA Langley Research Center, Hampton, VA 23681; *Email:* s.w.moore@larc.nasa.gov

○ University of Montana's Earth Observing System (EOS) Education Project

http://www.eoscenter.com

This project disseminates EOS mission imagery, supportive curriculum, and relevant programs to the K–16 education community. The **EOS Education Project** also provides training for the K–16 educational community in the interpretation, utilization, and relevancy of EOS mission imagery. These resources are delivered through a dynamic combination of online and onsite teacher workshops, Internet-based courses, national conferences, interactive map and image servers, and Earth system science content.

Distributed and classroom-based Geographic Information Systems (GIS) are used to assist teachers to obtain remote-sensing imagery and ancillary data for project-based learning. The project investigates how EOS information can enhance existing NASA interdisciplinary curriculums that explore the diverse and changing landscapes of the world.

The EOS Education Project has assembled a team of education, technology, and resource specialists to serve the growing needs of the global environmental education community. The project has also established strategic alliances within the private and public sectors to advance state-of-the-art solutions for geographical information dissemination and education program development across local, regional, and global scales. The collective mission supports educator and student understanding of complex global ecosystems and humans' role in affecting these systems.

CONTACT: *Phone:* 1-800-0411-0341; *Email:* umtonline@selway.umt.edu

POSTSECONDARY

○ The Journal of Earth System Science Education (JESSE)

http://jesse.usra.edu

The Journal of Earth System Science Education (JESSE) is a new interdisciplinary electronic journal aiming to foster the study of the Earth as a system while experimenting with the peer review process. JESSE is creating, implementing, testing and evaluating a peer review process embracing anonymous and open review of educational resources. JESSE aims to optimize the efficiency of the review process and the quality of offerings in advancing the educational agenda of the National Science, Mathematics, Engineering and Technology Digital Library (NSDL) while providing professional recognition for authors and creators of interdisciplinary education resources through publication in a peer reviewed journal.

JESSE is seeking electronic submissions that address understanding the Earth as a system. Authors are encouraged to submit learning resources and modules, courses, texts, articles, research results on Earth system learning and best pedagogical practices, lesson plans, visualization tools, image collections, etc. Authors retain copyright and JESSE maintains an electronic archival copy of all resources published. Guidelines for authors are available on the Web site listed.

CONTACTS: Donald Johnson, *Phone:* 608-262-2538, *Email:* donj@ssec.wisc.edu—or: Martin Ruzek, *Phone:* 920-732-3316, *Email:* ruzek@usra.edu; Universities Space Research Association, 7501 Forbes Blvd, Suite 206, Seabrook, MD 20706.

○ Minority University-SPace Interdisciplinary Network (MU-SPIN)

http://muspin.gsfc.nasa.gov/main/index.html

To help train the next generation of NASA's minority scientists and engineers, NASA's Office of Equal Opportunity Programs created **MU-SPIN** in 1991. The program has remained a highly effective tool as it has continually grown and evolved over the past decade. MU-SPIN serves America's Historically Black Colleges and Universities (HBCUs) and Other Minority Universities (OMUs). OMUs include Hispanic Serving Institutes and Tribal Colleges and Universities.

The first step for the MU-SPIN program was to help provide campuses and schools with network infrastructure. MU-SPIN helped minority schools buy and even build their own computers for the classroom.

In MU-SPIN's next phase, the program established regional hubs to help extend its program to an even larger minority community. To do this, NASA established Network Resources and Training Sites (NRTS). With the NRTS, the program expanded, targeting students from kindergarten through college, faculty, administrators, and community members.

With the infrastructure and regional hubs in place, MU-SPIN established Expert Institutes. These institutes help foster scientific curriculum development and research with the goal of increasing participation in NASA-related science, with a strong emphasis on Earth science.

To further expand its reach, MU-SPIN created the Institutes for Collaborative Research and Education (ICRE) model. This approach facilitates leadership of current partners and encourages involvement of new partners.

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○ Scenario-Based Learning: Inquiry for a Digital Earth

While text-based media can provide a wealth of information, retention of data and facts by learners is significantly limited. In contrast, a graphical representation, e.g. maps, remote-sensing images, and photographs, allows one to absorb billions of bits of data instantly. Although multi-dimensional graphical virtual worlds are being used for many applications, their full potential for learning is yet to be tapped. The objectives of this project are:

☐ Develop and test scenarios that utilize resources that will be avail-

able via **Digital Earth.** How will the Digital Earth network facilitate the goals of the individuals involved in a scenario? How will individuals use the available data?

- ☐ Investigate whether multi-dimensional graphical virtual worlds and the scenario-based learning strategy provide an effective learning environment. What would they learn? Are these worlds more appealing? What are the design criteria for these scenarios to be effective learning environments?
- ☐ Produce a low-resolution 3-D Earth with geo-referenced data, which could be accessible by high-end desktop machines. Could high-end desktop machines maximize the use of Digital Earth resources?
- ☐ Involve individuals of groups that have traditionally been underrepresented in Earth science in the creation and usage of Digital Earth resources.

This project is investigating the use of visualization with Digital Earth scenarios at multiple levels of the technology spectrum—first, an immersive virtual reality system similar to those used by scientific researchers; and second, three-dimensional interactive graphical worlds that can run on a desktop workstation and initially, paper and pencil exercises whose creation is guided by research into student learning. Scenarios created for these different levels of visualization will be tested with undergraduate students to test their ability to learn and make high-order decisions based on the knowledge acquired with these multi-dimensional, virtual worlds.

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S. Raj Chaudhury, BESTLab/Physics, Norfolk State University, 700 Park Avenue, Norfolk, VA 23504; *Phone:* 757-823-2241; *Fax:* 757-823-2286; *Email:* schaudhury@nsu.edu

NASA's Earth science education program **supports the systemic improvement** of education through initiatives and partnerships that integrate Earth system science content into the state and local education at precollege and university levels.

ELEMENTARY & SECONDARY

Alaska Alliance for Earth System Science Education

The objectives of the **Alaska Alliance** are twofold: 1) to increase public understanding of global climate variability and its relevance to Alaskan communities; and 2) to strengthen teaching and learning of related subjects in the K–16 classrooms. To accomplish its objectives the project is:

- ☐ adapting appropriate science and technology content and education materials that have already been developed and tested (e.g., NASA Earth science education resources);
- ☐ improving systemic efforts by linking existing programs with Earth and environmental education institutions; and
- ☐ augmenting existing capabilities to enable these programs to increase their scope and reach, particularly within rural Alaska.

The Alaska Alliance includes the participation of the following organizations: The Global Learning and Observations to Benefit the Environment (GLOBE) partners and schools; The Alaska Space Grant Program; Kachemak Bay National Estuarine Research Reserve (KBNERR); and Challenger Learning Center of Alaska.

CONTACT: Elena Sparrow, Associate Professor and Alaska GLOBE Partner Coordinator, 317 O'Neill Bldg., PO Box 757200, SALRM, University of Alaska Fairbanks, Fairbanks, Alaska 99775-7200; *Phone:* 907-474-7699; *Email:* ffebs@aurora.uaf.edu

Maryland Earth and Space Systems Science Curriculum Project

NASA's Goddard Space Flight Center Education Office is collaborating with two Maryland school systems, Anne Arundel County Public Schools and Montgomery County Public Schools, to develop a new high school Earth and Space Systems Science curriculum. This curriculum will address the National Science Education Standards and Maryland's "Core Learning Goals," **http://mdk12.org/mspp/high_school/what_will/science/index.html**, which will provide the basis for high school performance tests. The curriculum will use a systems approach and be grounded in current Earth and space system science content.

Two courses are being developed: 1) a course for students in grades nine or ten (with Algebra One as a pre-/co-requisite) and 2) a course for students in grades eleven and twelve (with Algebra Two as a pre-/co-requisite).

The writing team is using information provided by NASA scientists as a basis for the content. The "Five E" format, from Constructivist Learning Theory, **http://www.exploratorium.edu/IFI/resources/constructivistlearning.html**, is providing the model for the curriculum design. Throughout curriculum development, Goddard's scientists have been and will continue to be consulted by the writing team to ensure accuracy of content and that the latest scientific facts, theories, and processes are incorporated into the curriculum. An advisory board will be identified to review the curriculum writing efforts.

Initial implementation of the first level of the course began in September 2000 with revisions to the first course and development of the second level course planned for the 2000/2001 school year. Goddard will provide a Web site for curriculum dissemination so that the curriculum will be made available to other school systems.

CONTACT: Mrs. Rochelle Slutskin, AACPS Coordinator of Science, 2644 Riva Rd., Annapolis, MD 21401; *Email:* rtshelli@clark.net—or: Dr. Robert Gabrys, Goddard Space Flight Center, Code 130.3, Building 28, Room N167A, Greenbelt, MD 20771.

60

NASA Earth Science Education Products Workshops

The Institute for Global Environmental Strategies (IGES), through funding from NASA's Earth Science Enterprise, convenes an annual workshop for representatives from NASA Educator Resource Centers (ERCs), Aerospace Education Services Program (AESP), and Teaching from Space (TFS) Program.

Participants receive training in new NASA Earth science education products that they can distribute through their ongoing in-service teacher workshops. Participation in the annual workshop is limited to NASA ERC, AESP, and TFS representatives. These representatives then hold teacher workshops in their state, where the products are made available to teachers. Contact IGES for information on NASA educators in your state who are conducting Earth science workshops for K–12 teachers.

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PIPELINES

www.phys.subr.edu/pipelines

The **Program to Increase the Pursuit of Education and Learning IN Engineering and Science (PIPELINES)** is a partnership between Southern University and A&M College (SUBR) in Baton Rouge and Iowa State University (ISU). PIPELINES supports activities in Earth and environmental science for students and teachers in K–12, undergraduates, graduates and university faculty. Major components of the program are:

☐ ***Educational reform and support for standards-based curriculum, teaching, and learning***
Both SUBR and ISU offer in-service workshops designed to promote and support standards-based education, with emphasis on science and mathematics education in general and Earth and environmental science education in particular. These workshops are for pre-college teachers and college faculty. Additionally, the SUBR College of Education's Curriculum Center serves as a statewide repository for instructional materials and supplies for teachers in science and mathematics. The center holds regular workshops to aid teachers in preparing meaningful lessons and activities for students.

☐ **Global Learning and Observations to Benefit the Environment (GLOBE)**
GLOBE **(http://www.globe.gov)** is a worldwide network of K–12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near their schools and report their data via the Internet. The SUBR-GLOBE Partnership provides GLOBE certification training in the basic GLOBE protocols. Teacher participants receive GLOBE materials and supplies, as well as stipends for after-school, weekend, and holiday sessions.

☐ ***Undergraduate Research Support***
PIPELINES supports twenty high-achieving undergraduate students in science, mathematics, and engineering to conduct Earth science research at NASA Field Centers during the summer or at SUBR or ISU.

☐ ***Earth Science at the Timbuktu Academy (ESTA)*** at SUBR is a six-week residential program that provides intensive academic enrichment designed to enhance the academic achievements of pre-college students (i.e., ACT/SAT). Students are exposed to Earth and environmental science education and research, through GLOBE, and to career opportunities. Future college matriculation in Earth science related fields is a major objective of this activity. The Science Bound Program, at ISU, similarly engages pre-college students in academic enrichment activities.

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Regional Earth Science Applications Centers (RESACs)

http://www.esad.ssc.nasa.gov/resac/resacmain.asp

The **RESACs** are funded by NASA to: 1) apply remote sensing and geospatial technologies to well-defined problems and issues of regional significance; 2) integrate these technologies into the local decision-making process; and 3) support regional assessments associated with the U.S. Global Change Research Program (USGCRP). The seven RESAC's each engage in key regional issues, including precision farm management, land cover/use mapping, urban sprawl, fire hazard management, and K–12 education.

☐ ***Northeast Applications of Useable Technology In Land Planning for Urban Sprawl RESAC (NAUTILUS)***
Impacts of urban/suburban growth and land use change on local communities and natural habitats.
http://resac.uconn.edu

☐ ***The Mid-Atlantic RESAC Consortium: Remote Sensing for Resource Management***
Integrated watershed and coastal management (concentrating on the Chesapeake Bay), agricultural and land management information systems, land planning applications, and environmental monitoring.
http://www.geog.umd.edu/resac

☐ ***Integrated Upper Midwest RESAC***
Minnesota, Wisconsin and Michigan
Precision agriculture, forest growth and health, and water and ecosystem resources.
http://resac.gis.umn.edu

☐ ***Northern Great Plains RESAC***
North Dakota, South Dakota, Montana, Wyoming, Idaho, and northwestern Minnesota
Providing soil water estimates to the region's farmers and ranchers and K–12 education.
http://www.umac.org

☐ ***Great Plains RESAC***
Remote-sensing products and technology to support the Great Plains Agrosystem.
http://www.kars.ukans.edu/resac/resac.shtml

☐ ***Integrated Southwest RESAC***
Arizona, New Mexico, California, Colorado, Nevada, and Utah
Application of remote sensing and regional climate modeling to water resource applications such as flood forecasting and snow mapping.
http://resac.hwr.arizona.edu

☐ ***Wildlands Fire Hazard RESAC***
Southern California
Managing fire hazards at the urban-wildlands interface.
http://wildfire.geog.csulb.edu/resac/main/netresacmain.htm

○ The Tropical Center for Earth and Space Studies (TCESS)

http://tcess.uprm.edu

The **TCESS** at the University of Puerto Rico at Mayaguez (UPRM) is a NASA University Research Center (URC)—multidisciplinary research units established at minority institutions to focus on a specific area of NASA interest.

The Center's education component is GLOBE-TEST (Teachers Enhancement in Science and Technology)—a comprehensive project to align science, environmental education, and technology with current state educational reforms. The initiative will integrate sensors, calculator-based laboratory (CBL) technology, and geographic information systems (GIS) techniques, as well as the GLOBE (Global Learning and Observations to Benefit the Environment, **http://www.globe.gov**) protocols to current laboratory and curriculum in chemistry, biology, and mathematics. The overall goal of the GLOBE-TEST project is, by the year 2005, to transform a significant number of in-service and pre-service teachers into proficient educators in the areas of science and technology.

The project has designed a professional development program that combines workshops, Saturday academies, follow-up activities, and visits to schools as well as activities for teacher, faculty, parent, and student involvement. Intensive weeklong workshops and Saturday academies will provide teachers the opportunity to become skilled in the TEST activities through hands-on experiences. Follow-up activities will bring the teachers and their students to the TEST facilities at the University to integrate the science knowledge that is part of their K–12 curriculum and the TEST experiences. In-site visits to the schools will then reinforce the teacher's project role. Overall, in five years, the GLOBE TEST project will influence more than two hundred Hispanic teachers and more than six thousand Hispanic students.

CONTACT: Rafael Fernández-Sein, Director, Tropical Center for Earth and Space Studies (TCESS), University of Puerto Rico–Mayagüez; *Email:* rafael@ece.uprm.edu

ELEMENTARY & SECONDARY

○ NOVA

http://education.nasa.gov/nova

NASA Opportunities for Visionary Academics (NOVA) was created to develop and disseminate a national framework for enhancing science, mathematics, and technology literacy for teachers in the 21st century. The NOVA consortium, with the University of Alabama, Fayetteville State University, and the University of Idaho as lead institutions, is working to produce enhanced science, mathematics, and technology literacy for new teachers. This effort is accomplished through demonstrating an undergraduate science/math/technology course framework, examples of successful course models, and a mentoring support system for faculty wishing to implement new courses or modify existing courses at their universities. The framework uses interactive learning and integrates science, mathematics and technology as a means of developing a new paradigm for educating teachers. NOVA invites the participation of science, mathematics, engineering, technology, and education faculty who are concerned with

how universities prepare new teachers. Using the NASA mission, facilities, and resources, NOVA provides faculty with enhanced knowledge and skills to implement change in university courses. The NOVA team presents its framework for change primarily through three-day workshops to interdisciplinary university teams. These universities are then eligible to submit proposals for Implementation Planning Grants (up to $30,000 for a one-year period) to initiate change in science, mathematics, or engineering courses for preparing K–12 teachers. In addition, the project links participants together through the NOVA Network, which provides the means for faculty and students to exchange and have access to the model, materials, activities, and updated information.

The schedule of workshops and application information is available at **http://education.nasa.gov/nova**. Each participating university or college must identify an interdisciplinary faculty team for the workshop. One team member must be a faculty member in the College of Education. A second team member must be a faculty member in science, mathematics, engineering, or technology. The third team member should be a university or college administrator (e.g., provost, dean, or department head). Applying teams must have access to interactive technologies and the Internet for classroom use. A memorandum of understanding signed by the deans of each college or division participating in the project must be submitted to demonstrate a university-wide commitment.

CONTACT: L. Michael Freeman, Aerospace Engineering & Mechanics, University of Alabama, Box 870280, Tuscaloosa, AL 35487-0280; *Phone:* 205-348-7304; *Fax:* 205-348-4171; *Email:* nova@coe.eng.ua.edu, or: mike.freeman@ua.edu

○ University Based Program in Earth System Science Education (ESSE)

http://www.usra.edu/esse/essonline

The ESSE program consists of faculty from 44 U.S. universities who are linked with one another and with NASA scientists in the development of undergraduate curricula in Earth system science. Managed by the Universities Space Research Association (USRA), the program offers financial incentives to universities that are willing to participate cooperatively with other universities and NASA in interdisciplinary curricula development for Earth system science education. Each university in the program has developed a survey course and senior-level courses in which faculty present Earth system issues as a socially-relevant, challenging, and important class of scientific problems. The objective of the survey-level course is to instill among the general student population an appreciation of the social, economic, and political implications of global change, and a scientific understanding of interrelationships between the Earth's physical and climate system and ecological systems. The objective of the advanced senior-level course is to provide students in the sciences and mathematics with an interdisciplinary perspective of Earth science and global change research. In the senior course, students from different academic departments work in teams to study and develop conceptual and computer models of physical, chemical, and biological processes of the Earth system. The senior course is taught by faculty from at least two relevant academic departments and focuses on scientific issues that draw upon the strengths of the institution. As part of the broader program, universities participate in an organized exchange of scientists and faculty, involving visiting faculty and scientists from other participating universities and from NASA Centers.

CONTACTS: Donald Johnson, *Phone:* 608-262-2538, *Email:* donj@ssec.wisc.edu; Martin Ruzek, *Phone:* 920-732-3316, *Email:* ruzek@usra.edu; Universities Space Research Association, 7501 Forbes Blvd, Suite 206, Seabrook, MD 20706.

Informal Education

NASA's Earth Science Enterprise (ESE) Informal Education Program seeks to increase public awareness, appreciation, and understanding of: a) how the Earth functions as a system; and b) NASA's role in enabling development of knowledge about Earth System Science. The program promotes science literacy by enhancing lifelong learning opportunities in the area of Earth System Science.

Informal learning opportunities arise in many venues, including museums, science centers, aquaria, zoos, public lands management groups and agencies, community groups, youth groups, and the mass media. NASA's ESE is expanding efforts at building and maintaining relationships with the informal education community, focusing on providing content and expertise for these professionals. The program also develops and distributes a rich variety of Earth System Science education resources and materials that can be used by informal educators and audiences. These products are included in the "Resources" section of this catalog (page 63). The following pages describe informal education projects and activities that are supported by NASA ESE.

CONTACT: Anita Davis, Informal Education Lead, NASA Earth Science Enterprise, Code 900.2, Earth Science Education Implementation Office, Goddard Space Flight Center, Greenbelt, MD, 20771; *Phone:* 301-286-8591; *Email:* adavis@see.gsfc.nasa.gov

The Dynamic Earth

http://www.discoverycube.org

Discovery Science Center is an interactive science center with over 100 hands-on exhibits augmented by educational programming and materials providing learning opportunities for students, teachers, and family audiences. **The Dynamic Earth** program includes:

- ☐ Resource materials and kits provide the classroom teachers with a set of hands-on materials that will enable the students to design and test experiments. The curriculum packet contains science content information, vocabulary list, a materials list, timeline for preparation and implementation, tips for managing the students or classroom during hands-on experiences, a bibliography of additional materials, and a collection of professional contacts.
- ☐ Teacher training program in the use of these materials and lesson plans. This six-hour training, along with the teacher's guide and kit, will enable two to three weeks of classroom instruction.
- ☐ An interactive science presentation for the classroom or general public.
- ☐ Family science nights at the science center. These evenings will introduce families to the science programs presented in the schools. Families will observe science demonstrations, attend science lectures, interact with the hands-on exhibitry, such as an earthquake simulation room, an eight-foot free-standing tornado, and a kalliroscope that models the fluid dynamics of the ocean and/or the atmosphere.

Some of the concepts The Dynamic Earth participants will investigate are:

- ☐ Plate tectonics and the changing patterns of land, sea, and mountains on the Earth's surface;
- ☐ How the sun's heating of the Earth's surface drives convection within the atmosphere and oceans, producing winds and ocean currents, leading to an understanding of global weather patterns and geographical distribution of marine and terrestrial organisms; and
- ☐ Human impact on the Earth's atmosphere, and in turn how the altered atmospheric conditions affect all life on Earth.

Interested parties should contact the Education Department or Group Bookings at 714-542-2823.

CONTACT: Janet Yamaguchi, Vice President, Education, Discovery Science Center, 2500 North Main Street, Santa Ana, CA 92705; *Phone:* 714-542-2823; *Fax:* 714-542-2828; *Email:* jyamaguchi@discoverycube.org

Earth & Sky Broadcast Fellowship

http://www.earthsky.com

The **Earth & Sky** radio series, in cooperation with NASA's Earth Science Enterprise, selects two radio journalism fellows each year to record interviews with NASA scientists and produce segments of the Earth & Sky radio series. The fellows travel to Austin, Texas to work for five weeks in the summer. Housing and travel expenses are paid as well as an hourly salary. Each fellow:

- ☐ Works with NASA scientists and Earth & Sky producers to identify newsworthy topics about NASA science.
- ☐ Gathers information and records interviews with NASA scientists about these topics.
- ☐ Prepares and writes scripts for radio programs on NASA Earth and space sciences.

Earth & Sky is an internationally-syndicated, daily science radio series. Broadcasting since 1991, Earth & Sky is funded by the National Science Foundation, NASA, the U.S. Forest Service, and others. Audience measurements indicate that the program has four million listeners each week in the United States alone.

The deadline for submission of applications for the fellowship is January 31 each year. Preference will be given to applicants with experience in writing for broadcast, but all applicants are welcome. More information is available online at **http://www.earthsky.com.**

CONTACT: Marc Airhart, P.O. Box 2203, Austin, TX 78768; *Phone:* 512-477-4441; *Email:* mairhart@earthsky.com

Earth Science Enterprise Museum Support

The goal of this program is to understand how NASA Earth Science can best address the needs of informal educators, especially at museums, science centers, aquaria, and zoos. In 1999, NASA's Jet Propulsion Laboratory (JPL) worked with the Denver Museum of Natural History and 11 other museums to develop and conduct a survey of informal education priorities in Earth Science and interests in future programs. In 2000, development began on programs identified in the survey, including Earth Science workshops and Digital Earth informal education partnerships. In 2001, this work continued with staff exchange between the American Museum of Natural History's Science Bulletins project, visualizations of the Mississippi River from its mouth to its source (for the Science Museum of Minnesota) and San Diego, and the first week-long Earth Science Institute for museum educators, held at the Science Museum of Minnesota. Representatives from 20 museums across the country received an overview of NASA Earth system science content and resources, and prepared action plans for using this information in their own institutions. Plans for 2002 include continued staff exchange, the second Earth Science Institute for museum educators, and continued development of relationships with a broad spectrum of informal science education organizations across the U.S.

CONTACT: Marguerite Syvertson, 4800 Oak Grove Drive, Pasadena, CA 91109; *Phone:* 818-354-6492; *Fax:* 818-393-6546; *Email:* marguerite.syvertson@jpl.nasa.gov—or: Anita M. Sohus, 4800 Oak Grove Drive, Pasadena, CA 91109; *Phone:* 818-354-6613; *Fax:* 818-354-7586; *Email:* Anita.M.Sohus@jpl.nasa.gov

Electronic Theater Presentations

http://etheater.gsfc.nasa.gov

Large screen format digital theater presentations displaying new NASA Earth science data sets in high definition are available to technical and non-technical audiences. Presentations demonstrate new science results using the latest information technology tools in an interactive digital presentation. An increasing number of presentations are offered annually around the country and the world to audiences of the international science and technology community. At least 3 months notice is preferred for scheduling.

CONTACTS: Fritz Hasler; *Phone:* 301-614-6270; *Email:* hasler@agnes.gsfc.nasa.gov—or: Mike Manyin, Phone: 301-614-6329; *Email:* manyin@agnes.gsfc.nasa.gov; Code 912, NASA Goddard Space Flight Center, Greenbelt, MD 20771.

Environmental Education Initiative—Field Museum of Chicago

www.fieldmuseum.org

The **Field Museum's** K–8 environmental education initiative uses a multidisciplinary and multimedia approach to teach students and teachers about the environment. Several components comprise the initiative: 1) the "Underground Adventure" exhibition, which focuses on soil as a vital resource; 2) two traveling outreach vehicles call SAMs (Soil Adventure Mobiles) that bring soil activities to parks and schools in the Chicago region; 3) inquiry-based K–8 education curriculum support materials that examine the Earth system in a social and political context; 4) professional development seminars for teachers; and 5) distance learning programs. Through these programs,

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the Field Museum is providing students and teachers a variety of ways to learn about the environment and strive to increase their awareness of environmental issues and actions. In addition to engaging in hands-on activities, participants have the opportunity to interact with scientists from The Field Museum and become familiar with people, animals, and plants from different global communities through technology.

CONTACT: Field Museum, Education Department, 1400 S. Lake Shore Drive, Chicago, IL 60605-2496.

Eyes on Earth

The Oregon Museum of Science and Industry (OMSI) is building an interactive traveling exhibition consisting of 10 and 15 exhibit units that focuses on NASA's Earth Observation System (EOS) missions. During its eight-year tour, the approximately 2,000-square foot **Eyes on Earth** is projected to visit twenty-four museums around the nation and be viewed by more than four million people.

This exhibition is intended to present science center visitors with a suite of hands-on exhibits that will convey the value of observing the Earth from space as well as the means by which scientists are studying our home planet. The conceptual approach is to highlight the various EOS missions as they help us understand the Earth. This involves a blending of a variety of research areas such as meteorology, oceanography, biology, and atmospheric science. The exhibit concepts represent NASA missions that support these fields. The exhibits will be interactive, providing opportunities for the visitor to learn about EOS at their own ability level and pace.

A teacher's guide to the exhibit, available on the Web and in hard copy, is planned to support the exhibition.

CONTACT: Raymond J. Vandiver, Ph.D., Science Director, Oregon Museum of Science and Industry, 1945 SE Water Avenue, Portland OR 97214-3354; *Phone:* 503-797-4643; *Fax:* 503-797-4500; *Email:* Ray.Vandiver@omsi.edu

Forces of Change

Forces of Change is a comprehensive program being developed by the Smithsonian's National Museum of Natural History, through funding from NASA and other donors, to explain the geological, environmental, and historical processes that have shaped our world. It will consist of a permanent exhibit in the Museum, traveling exhibits, publications, interactive computer programs, and public programming which will include a lecture series and electronic classroom courses.

The cornerstone of the Forces of Change program will be a permanent exhibit in the National Museum of Natural History. The 5,400 sq. foot display will examine the forces of change that have shaped and sustained the Earth since the beginning of geologic time. The goal of the exhibit will be to inform visitors about the history and present condition of our environment as the world starts the 21st century. The exhibit will be a marriage of traditional and high-tech approaches to learning about Earth systems and managing our precious natural resources. A key feature of the Forces of Change Hall will be the Global Links exhibit (see next column), a multi-media display of remote-sensing imagery, real-time data links, historic evidence and other techniques that demonstrate how the Earth is affected by geological, environmental, and human changes, and how all of these processes are interconnected. A rotating case study area will highlight regional themes, changing every two years and allowing visitors to learn about how global forces have affected specific parts of the planet. Regional studies under consideration are the North American Grasslands, Hawaii, the Chesapeake Bay, Amazonia, and Antarctica.

In addition to the exhibit, Forces of Change will be available in a variety of formats—videos, CD-ROMs, and posters—for use in: classrooms, municipal buildings, malls, and airports. Listening to the Prairie, a traveling exhibit on agriculture in the North American grasslands, is touring the country through 2004, and a richly illustrated coffee-table book, titled *Forces of Change,* has been published by National Geographic.

CONTACT: Barbara Stauffer, National Museum of Natural History, Office of Exhibits, 10th and Constitution, Washington, DC 20560 -0101; *Phone:* 202-357 -2377; *Fax:* 202-786 -2567; *Email:* stauffer.barbara@nmnh.si.edu

Global Links

The National Museum of Natural History's Forces of Change (see above) program will collaborate with NASA to design an exhibit about Earth system science, called **Global Links.** The exhibit will advance the public's understanding of Earth system science by combining NASA's expertise in space-based observations with the Museum's renowned collections and expertise in object-based science education. By relating museum specimens with remote-sensing visualizations, the exhibit interpretation will capitalize on the unique capability of space-based imagery to present a global perspective of the Earth and the unique appeal of seeing and interacting with tangible evidence of the Earth's dynamics and history.

With this prototype, the Forces of Change team hopes to begin dialogues

with outside museums interested in Global Links displays of their own. After installation of the Global Links exhibit at the Museum, a "kit" will be assembled and made available to interested museums following the installation of the Global Links exhibit at the Museum. Contents of the "kit" will include: software for computer interactives, exhibit script, design drawings, fabrication blueprints, installation guidelines, technical specifications, slides and transparencies of appropriate images, a Web link, resource lists, and other helpful material as it is identified during the museum assessment and exhibit development process. Also, survey and field test results will be assembled, duplicated, and made available to NASA and interested museums.

CONTACT: Barbara Stauffer, National Museum of Natural History, Office of Exhibits, 10th and Constitution, Washington, DC 20560 -0101; *Phone:* 202-357 -2377; *Fax:* 202-786 -2567; *Email:* stauffer.barbara@nmnh.si.edu

○ Museums Teaching Planet Earth

http://mtpe.com/mtpe/mtpe.html

Museums Teaching Planet Earth (MuTPE) is an innovative program sponsored by the ESIP (Earth Science Information Partnership) Federation, a NASA Earth Science Enterprise program. MuTPE uses three independent mechanisms for educating the public about Earth science:

- ☐ ***Earth Update:*** An interactive educational computer program, suitable for a stand-alone exhibit at a museum or school or as a CD resource for personal use. This linked set of six interactive real-time computerized modules (which can run independently or as a single exhibit) shows real-time data in five spheres: atmosphere, biosphere, cryosphere, geosphere, and hydrosphere.
- ☐ ***Globe Theater:*** Rice Space Institute is creating an immersive theater, with full-dome digital productions using "SkyVision" projection technology from Sky-Skan of Nashua, NH.
- ☐ ***Earth Forum:*** A successful, operational simulator and exhibit at the Houston Museum of Natural Science. In simulator mode, the Earth Forum is designed for 24–36 visiting students staying 1.5–2.5 hours. Students in teams are assigned to work stations representing the world's continents and resources. Faced with the challenge of an increasing global population, students will use MuTPE databases to evaluate the effects on their continent and resource. Students are assigned roles as geographers, demographers, statisticians, resource scientists, and political scientists. MuTPE is updating the Earth Forum to include MuTPE databases and reconfigure it to emphasize specific problems addressable by MuTPE data and Shuttle images of Earth.

Each of these projects is being developed at Rice University and the Houston Museum of Natural Science (HMNS) and field tested at HMNS and at the Carnegie Museum of Natural History (CMNH). As each product is fully tested it will be available for replication at other museums and schools around the nation.

Contact: Patricia Reiff, Rice Space Institute, MS-108 6100 Main Street, Houston, Texas 77005; *Phone:* 713-348-4634; *Fax:* 713-348-5143; *Email:* reiff@rice.edu

○ NASA–National Park Service Partnership

NASA and the National Park Service share a common goal of improving public awareness and appreciation of science. Through an active partnership, the two agencies: share expertise in data visualization and displays; explore and develop use of remote-sensing data for natural resource management applications; link similar Web site topics from each organization; develop interpretive products for technical and scientific information; participate in professional association and community events; and share training and expertise to communicate to broad and diverse audiences. The partnership has strengthened and made richer each organization's efforts, with visible results in many of the over 375 National Parks.

CONTACT: Lynn Murdock, National Park Service, 1849 C St. NW, Washington, DC 20002; *Phone:* 202- 565-1221.

○ Reach for the Stars: Girl Scouts of the USA, Science and NASA

http://www.girlscouts.org

Girl Scouts of the USA has teamed up with **NASA** in an effort to support new and existing local Girl Scout council and national science initiatives. This collaboration is designed to:

- ☐ Enhance Girl Scout programs designed to increase girls' and adults' understanding of, and interest in, science.
- ☐ Build on existing Girl Scout science, math, and technology curriculum through in-depth exploration of science topics.
- ☐ Provide opportunities for girls to discover diverse career options.

Some of the resources available to the councils are:

- ☐ fun, hands-on, interactive science activities available for their science events,
- ☐ online access to science activities through the Just 4 Girls pages **(http://jfg.girlscouts.org)**,
- ☐ Scout Interest Project awards,
- ☐ event speakers, including women scientists,
- ☐ training workshops on Earth science topics, and
- ☐ participation in special events sponsored by NASA.

NASA Langley Research Center designs and sponsors workshops especially for Girl Scout trainers. These workshops develop Girl Scout trainers' skills and comfort levels in training Girl Scout leaders in topics such as Earth system science, climate change, and atmospheric science. Workshop participants are able to return to their councils ready to train leaders to work with girls in the areas of Earth system science and global climate change. Some of the workshops are available by videoconferencing.

Workshops for Girl Scout trainers of volunteers are available by application. Interested trainers can check with their local Girl Scout council for the latest information on upcoming workshops.

CONTACT: Arlene S. Levine, Mail Stop 401, NASA Langley Research Center, 21 Langley Boulevard, Hampton, VA 23681-2199; *Phone:* 757-864-3318; *Email:* A.S.Levine@larc.nasa.gov

68

Workforce/Professional Development

Professional and workforce development is a new and growing area of NASA's Earth Science Enterprise. The following paragraphs describe NASA ESE's efforts in this area.

NASA Workforce/ Professional Development Program

Professional and workforce development is an emerging area of NASA's Earth Science Education Program that will identify and address requirements for developing and enhancing job skills for an Earth system science, applications, and technology workforce.

Several components of this emerging program include developing collaborative partnerships with other government, academic, and private sector organizations. A second component will focus on creating and maintaining a Workforce Competency Model that reflects current and projected workforce needs in this area. The third component will focus on creating a program support structure that will bring continuity to the emerging remote sensing community it is intended to serve. Lastly, an entrepreneurial model embracing financial and operational self-sufficiency will be developed for individual workforce development projects and initiatives to consider. More to come as this program unfolds.

CONTACT: Dave Rosage, Code 160, Greenbelt, MD 20771; *Email:* david.rosage@gsfc.nasa.gov

Chesapeake Bay from Space

http://chesapeake.towson.edu

The **Chesapeake Bay from Space** Infomart provides remote-sensing resources for decision makers at the local, state, and regional levels. The Infomart contains a wide variety of data and tools designed to introduce decision makers to the use and interpretation of Landsat 7 imagery, with a primary focus on imagery used to measure the extent of impervious surfaces (i.e., land covers that repel water, restrict groundwater recharge, generate large volumes of storm water, and degrade water quality) in the Chesapeake Bay and Maryland Coastal Bays Watersheds.

The Infomart provides Landsat data as well as a variety of background information and educational tools designed for users outside the research-oriented community, including urban planning professionals, educators, and the general public. The Infomart was developed as part of NASA's Earth Observing System Data and Information system (EOSDIS) Synergy project, the purpose of which is to demonstrate the importance of remotely-sensed data to the non-research community.

The Chesapeake Bay from Space Infomart was developed through a partnership between the Center for Geographic Information Sciences at Towson University and the Raytheon Systems Company under the sponsorship of NASA.

CONTACT: Jay Morgan, Center for Geographic Information Sciences, Towson University, 8000 York Road, Towson, MD 21252-0001; *Email:* jmorgan@towson.edu

NASA Space Grant Extension Specialist in Geospatial Technology

http://aria.arizona.edu/extension/program.html

The **NASA Space Grant Extension Specialist in Geospatial Technology** (Geospatial Extension Specialist or GES) is a pilot program to explore how best to meet the needs of farmers, ranchers, planners, and others involved in agriculture, natural resource management, and rural development. It seeks to join the missions of the NASA Office of Earth Science and NASA Space Grant with the long-standing experience and existing infrastructure of the U.S. Department of Agriculture (USDA) Cooperative State Research, Education, and Extension Service (CSREES). The approach is to place an Extension Specialist in Geospatial Technology within CSREES of a Land Grant University. The specialist then

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characterizes the needs of the different constituencies in the state (e.g., farmers and foresters), and works with them to design solutions that meet their information needs within their budget and staffing constraints.

Three Initial GES projects have been put in place in Arizona, Mississippi, and Utah since 2000. Projects in Alabama, Connecticut and North Dakota started in 2002. All GES projects receive support from the NASA Office of Earth Science, Applications Division, and the NASA Office of Human Resources and Education, Space Grant Program. Additional GES projects are expected.

CONTACT: Edwin Sheffner, Code YO, NASA-HQ, Washington DC 20546; *Email:* esheffne@hq.nasa.gov

○ Regional Earth Science Applications Centers (RESACs)

http://www.esad.ssc.nasa.gov/resac/resacmain.asp

The **RESACs** are funded by NASA to: 1) apply remote-sensing and geospatial technologies to well-defined problems and issues of regional significance; 2) integrate these technologies into the local decision-making process; and 3) support regional assessments associated with the U.S. Global Change Research Program (USGCRP). The seven RESACs each engage in key regional issues, including precision farm management, land cover/use mapping, urban sprawl, fire hazard management, and K–12 education.

☐ ***Northeast Applications of Useable Technology In Land Planning for Urban Sprawl RESAC (NAUTILUS)***
Impacts of urban/suburban growth and land use change on local communities and natural habitats.
http://resac.uconn.edu

☐ ***The Mid-Atlantic RESAC Consortium: Remote Sensing for Resource Management***
Integrated watershed and coastal management (concentrating on the Chesapeake Bay), agricultural and land management information systems, land planning applications, and environmental monitoring.
http://www.geog.umd.edu/resac

☐ ***Integrated Upper Midwest RESAC***
Minnesota, Wisconsin and Michigan
Precision agriculture, forest growth and health, and water and ecosystem resources.
http://resac.gis.umn.edu

☐ ***Northern Great Plains RESAC***
North Dakota, South Dakota, Montana, Wyoming, Idaho, and northwestern Minnesota
Providing soil water estimates to the region's farmers and ranchers and K–12 education.
http://www.umac.org

☐ ***Great Plains RESAC***
Remote-sensing products and technology to support the Great Plains Agrosystem.
http://www.kars.ukans.edu/resac/resac.shtml

☐ ***Integrated Southwest RESAC***
Arizona, New Mexico, California, Colorado, Nevada, and Utah
Application of remote sensing and regional climate modeling to water resource applications such as flood forecasting and snow mapping.
http://resac.hwr.arizona.edu

☐ ***Wildlands Fire Hazard RESAC***
Southern California
Managing fire hazards at the urban-wildlands interface.
http://wildfire.geog.csulb.edu/res

70

Earth Science Education Products & Resources

NASA's Earth Science Education Product Review is a critical part of ESE's education program. This independent review includes panels of educators and scientists, who assess education materials based on their scientific accuracy and educational value. The review includes Earth system science education products developed by NASA, as well as materials developed by other agencies and organizations. Education products listed in this section have been reviewed and approved by NASA.

Beginning in 2001, ESE adopted a Seal of Approval for Earth Science education materials. NASA awards this distinction to education products that have passed its peer review. Products are due spring and fall for the review. For more information, see: **http://earth.nasa.gov/education/esereview/index.html**

Most of these materials listed here are available over the Internet. Many are also available at NASA Educator Resource Centers **http://spacelink.nasa.gov/erc** or for purchase from NASA's Central Operation of Resources for Educators **http://core.nasa.gov**, which distributes materials to teachers, nationally and internationally, for a shipping and handling charge.

Formal Education
- ☐ Elementary
- ☐ Middle School
- ☐ High School
- ☐ Postsecondary

Informal Education

Educational Resources
- ☐ Bookmarks
- ☐ Brochures
- ☐ NASA Earth Science Enterprise Science Writing and Multimedia Team
- ☐ Lithographs
- ☐ NASA Earth Science Missions—Education
- ☐ NASA Facts
- ☐ Newsletter
- ☐ Posters
- ☐ Videotapes
- ☐ Web Sites

ELEMENTARY & SECONDARY

CLASSROOM/CURRICULUM MATERIALS

○ ELEMENTARY

The Adventure of Echo the Bat Pop-Up Book

http://imagers.gsfc.nasa.gov/k-4/index.html

This picture book of Echo the Bat is accompanied by a set of activities that reinforce four basic themes or concepts fundamental to the interpretation of satellite imagery: perspective, shape and pattern, color, and texture. Activities and activity sheets are also provided on a companion Web site: **http://imagers.gsfc.nasa.gov/k-4/index.html.** *Recommended for:* K–4.

Earth & Sky

http://earthsky.com

Earth & Sky (E&S) and NASA's Earth Science Enterprise have collaborated on a series of 90-second radio programs highlighting ESE science, with scientists participating from Goddard Space Flight Center and Jet Propulsion Laboratory. The E&S radio series programs are produced for a measured audience of more than 3.8 million listeners (weekly). The E&S Web site contains links to the audio and text files for all E&S shows, as well as links to related educational resources. *Recommended for:* K–12 and informal education.

Earth Update

http://earth.rice.edu/connected/earthupdate.html
http://core.nasa.gov

Rice Space Institute developed this CD-ROM, which contains Earth science information, movies, and classroom activities. The CD is suitable as a stand-alone museum kiosk or for use in a school classroom or library. If the user's computer is connected to the Internet, today's data can be downloaded with a single click. Each "sphere" (Atmosphere, Biosphere,

Cryosphere, Geosphere, and Hydrosphere) can be run separately or as the linked Earth Update. Each sphere includes sections: What (What is the atmosphere), Who (Who studies the biosphere), Why (Why do we study the cryosphere?), and How (How do we study the geosphere?). Classroom activities aligned with national science, math, and geography standards are included on the CD. Also available from NASA CORE. *Recommended for:* K–12 and informal education.

Everyday Classroom Tools

http://hea-www.harvard.edu/ECT

The major theme explored in this curriculum is the pattern of change on planet Earth as it relates to the sun. So many different subjects can be usefully mapped to this set of investigations of the world around us that it gives educators an opportunity to build upon an inquiry framework with their own related and connected ideas from different disciplines. *Recommended for:* Grades K–6.

Exploring Earth from Space: Lithograph Set and Instructional Materials, LS-1999-05-001-HQ

http://spacelink.nasa.gov/products/Exploring.Earth.From.Space

Shuttle astronauts and the EarthKAM program provide photos of our planet from the unique perspective of Earth orbit. This resource can enhance students' studies of Earth and space science, geography, social studies, mathematics, and educational technologies. The set contains an educators' guide, student information and worksheets, and several Earth photos taken from the Space Shuttle. *Recommended for:* Grades 3–12.

Exploring the Environment

http://www.cotf.edu/ete

Online, problem-based modules developed by NASA's Classroom of the Future for K–4, 5–8, and 9–12 teachers and students. Modules address events such as volcanoes, hurricanes, dinosaur extinction theories, deforestation, endangered species, and global change. *Recommended for:* K–12.

From a Distance: An Introduction to Remote Sensing/GIS/GPS

http://education.ssc.nasa.gov/ltp

This Web site was developed and is maintained by NASA John C. Stennis Space Center. It includes lesson plans on remote sensing for grades K–3, 4–8, and 9–12 and links to related education resources. *Recommended for:* K–12.

Glacier Power

http://www.asf.alaska.edu:2222
http://core.nasa.gov

This 1997 CD-ROM is a curriculum supplement module on the topic of glaciers that was developed in cooperation with NASA by the Alaska Synthetic Aperture Radar Facility (ASF) at the University of Alaska, Fairbanks and in cooperation with the Fairbanks North Star Borough School District and the University of Alaska Fairbanks, School of Education.

The guide includes information on glaciers and their importance to climate studies; lesson plans; student review exercises, activities, and projects; and resources such as glacier imagery, satellite imagery, illustrations, diagrams, and more. Available online at (see Web site above) or on CD-ROM from NASA CORE. *Recommended for:* Grades 3–5.

GLOBE Program

http://globe.fsl.noaa.gov

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Mission Geography

http://missiongeography.org

Mission Geography is curriculum support materials that link the content, skills, and perspectives of *Geography for Life: The National Geography Standards* with the missions, research, and science of NASA. Developed by the Geography Education National Implementation Project (GENIP) at Texas A&M University. *Recommended for:* K–12.

Our Mission to Planet Earth: A Guide to Teaching Earth System Science, 1994

http://spacelink.nasa.gov/products/Our.Mission.to.Planet.Earth

Provides hands-on activities and information related to studying the Earth system. Its primary goal is for children to become familiar with the concept of cycles and to learn that some human activities can cause changes in their environment. *Recommended for:* Grades K–3.

72

The Potential Consequences of Climate Variability and Change

http://www.strategies.org/CLASS.html

This set of inquiry-based, classroom-ready activities for grades 1–12 includes 12 modules. The modules provide a climate change overview activity, as well as examine the relationship of climate change to areas such as agriculture, coastal areas, forestry, human health, and water. They contain activities developed with the purpose of introducing students to current research about the potential impacts of climate variability and change. Each activity responds to national education standards in the English language arts, geography, social studies, mathematics, and science. *Recommended for:* Grades 1–12.

Students' Cloud Observations Online (S'COOL)

http://scool.larc.nasa.gov

S'COOL is a component of NASA's Clouds and the Earth's Radiant Energy System (CERES) project, which is providing global data on clouds. S'COOL participants make ground truth measurements for the CERES experiment, which are land-based observations to compare with satellite data for the purpose of improving the satellite results. The S'COOL Web site provides information on the project and how to participate, as well as classroom materials and resources. *Recommended for:* Grades 3–12.

teachearth.com

http://teachearth.com

Searchable Web site with links to classroom materials and resources for teaching and learning about Earth system science. Users can search by grade level and subject. Developed by the Institute for Global Environmental Strategies. *Recommended for:* K–12.

Understanding the Biosphere from the Top Down

http://geo.arc.nasa.gov/sge/jskiles/top-down/intro_product/title-page.html

This Web site contains a 22-lesson package written by eight local teachers working with the advice and help of NASA Ames Research Center personnel in Earth Sciences. The lessons focus on studying the biosphere from space to teach students about the Earth system. *Recommended for:* Grades 4–12.

Virtual Vacationland

http://www.bigelow.org/virtual

Virtual Vacationland is a resource tool to help elementary and secondary teachers and students find and use Earth science data and information on the Internet. Content is arranged by science topic. Each topic has a preview page that summarizes the material. Each topic also has 2 to 5 detail pages, which show where to access online data and what the data mean. The site includes over 40 hands-on activities available on the following science topics, with new topics being added as the site grows: Land Topography; Ocean Bathymetry; Coastal Tides; Ocean Buoy Data; Ocean Temperature; Weather and Climate; and Watersheds and Rivers. *Recommended for:* Elementary–secondary.

Windows to the Universe

http://www.windows.ucar.edu

Windows to the Universe brings together scientific content on Earth and space sciences with interdisciplinary content on the arts and humanities, in order to provide a rich educational tool that satisfies the curiosity of a wide spectrum of learners as they seek to understand our world and space around us. Three levels of content are provided: students (K–12 through undergraduate), teachers, and browsing adults. The site includes a rich array of documents, images, movies, animations, sounds, games, and data that brings science to life for students, teachers, and the interested user. *Recommended for:* K–12, informal education.

○ MIDDLE SCHOOL

The Adventure of Echo the Bat

http://imagers.gsfc.nasa.gov

An interactive Web site allowing students to follow Echo the Bat as he migrates through Arizona. The adventure offers a directed and investigative approach to how land features look from space, what the colors mean in a Landsat image, and an introduction to identifying habitats in a false color Landsat image. The site is supported with a teacher's guide that includes the following units: Understanding Light, Remote Sensing, and Biodiversity. *Recommended for:* Grades 5–8.

Data Discovery: The Amazon

http://www.planearthsci.com

This CD-ROM brings Earth system science concepts to life in the classroom by challenging your students to conduct modern ecosystem research as it really happens. The multimedia learning tool engages students in a research expedition on the Amazon River flood plain, where they apply

modern chemical techniques and evaluate satellite data to discover the role of the floodplain in the trophic ecology of Amazon River fishes. Developed by Planet Earth Science and available for purchase from **www.amazon.com.** *Recommended for:* Middle–high school.

Data Discovery: El Niño

http://www.planearthsci.com

This CD-ROM engages students in a journey where they must navigate their own ship, operate modern research tools, and manipulate satellite and climate model data to investigate and help predict El Niño—one of our planet's largest global climactic disruptions. Developed by Planet Earth Science and available for purchase from **www.amazon.com.** *Recommended for:* Middle–high school.

Data Discovery: Ozone

http://www.planearthsci.com

In this adventure, middle-school students are "hired" to determine if the size of the Antarctic ozone hole is increasing. They set sail on the Research Vessel Glomar, this time in Antarctica, where they embark on their own investigation following the scientific method by testing a given hypothesis. To assist them, satellite images of ozone concentration and instructional movies are located onboard the ship. Developed by Planet Earth Science and available for purchase from **www.amazon.com** *Recommended for:* Middle–high school.

DataSlate

http://casde.jpl.nasa.gov/dataslate

DataSlate is a multi-curricular image visualization tool for students. It allows students to easily and quickly maneuver through huge image data sets, overlay and compare images gathered over time, or with different instruments, and observe historical, geographical, geological, and environmental change or to compare images of the same area at different wavelengths. DataSlate includes a CD-ROM (with 12 sample data sets and 12 sample lesson plans), video, and teachers' guide. *Recommended for:* Middle–high school.

Discover Earth Classroom Materials

http://www.strategies.org/CLASS.html

Discover Earth classroom materials were developed during a series of teacher workshops sponsored by NASA and implemented by the Institute for Global Environmental Strategies in collaboration with the Department of Meteorology, University of Maryland, College Park, and the Earth and Mineral Sciences Environmental Institute, The Pennsylvania State University. Modules include: Earth as a System; Albedo versus Temperature; Ozone; and Where Does the Rain Go? Each module includes: Key Concepts and Terms; Resources; Background for Teachers; and Classroom Investigations. *Recommended for:* Grades 5–12.

Dr. Art's Guide to Planet Earth

http://www.planetguide.net

Dr. Art's Guide to Planet Earth explains the Earth system using three concepts: 1.The cycles of matter; 2.The flows of energy; and 3.The web of life. The Guide then applies these concepts to real-life problems and issues that affect us and our planet. Developed by WestEd, Dr. Art's guide is available for purchase on the Web site above. *Recommended for:* Middle+.

Earth & Sky

http://earthsky.com

Earth & Sky (E&S) and NASA's Earth Science Enterprise have collaborated on a series of 90-second radio programs highlighting ESE science, with scientists participating from Goddard Space Flight Center and Jet Propulsion Laboratory. The E&S radio series programs are produced for a measured audience of more than 3.8 million listeners (weekly). The E&S Web site contains links to the audio and text files for all E&S shows, as well as links to related educational resources. *Recommended for:* K–12 and informal education.

Earth Update

http://earth.rice.edu/connected/earthupdate.html
http://core.nasa.gov

Rice Space Institute developed this CD-ROM, which contains Earth science information, movies, and classroom activities. The CD is suitable as a stand-alone museum kiosk or for use in a school classroom or library. If the user's computer is connected to the Internet, today's data can be downloaded with a single click. Each "sphere" (Atmosphere, Biosphere, Cryosphere, Geosphere, and Hydrosphere) can be run separately or as the linked Earth Update. Each sphere includes sections What (What is the atmosphere), Who (Who studies the biosphere), Why (Why do we study the cryosphere?), and How (How do we study the geosphere?). Classroom activities aligned with national science, math, and geography standards are included on the CD. *Recommended for:* K–12 and informal education.

Event-Based Science (EBS): Remote-Sensing Activities and other Modules

http://www.mcps.k12.md.us/departments/eventscience/rs.index.html

EBS/Remote-Sensing Activities enable middle school students to use remotely-sensed data—especially products from NASA sensors—as they tackle the real-world problems and tasks found in existing EBS modules. Remotely-sensed data are employed as an integral part of both the presentation of Earth system science concepts, and in the solutions to real-world problems. These activities emphasize the use of NASA remote-sensing data. The EBS remote-sensing activities enhance EBS modules, including: Blight! Earthquake! Fire! Flood! Hurricane! Oil Spill! and Volcano! *Recommended for:* Grades 5–8.

Exploring Earth from Space: Lithograph Set and Instructional Materials, LS-1999-05-001-HQ

http://spacelink.nasa.gov/products/Exploring.Earth.From.Space

Shuttle astronauts and the EarthKAM program provide photos of our planet from the unique perspective of Earth's orbit. This resource can enhance students' studies of Earth and space science, geography, social studies, mathematics, and educational technologies. The set contains an educators' guide, student information and worksheets, and several Earth photos taken from the Space Shuttle. *Recommended for:* Grades 3–12.

Exploring the Environment

http://www.cotf.edu/ete

Online, problem-based modules developed by NASA's Classroom of the Future for K–4, 5–8, and 9–12 teachers and students. Modules address events such as volcanoes, hurricanes, dinosaur extinction theories, deforestation, endangered species, and global change. *Recommended for:* K–12.

Exploring Wetlands with Satellite Sensing and Exploring Remote Sensing: A Hands-on Experience

http://baby.indstate.edu/gerstt/handson.html

In Exploring Wetlands, principles of remote sensing and examples of environmental applications using remote sensing present the background required for the hands-on CD. Exploring Remote Sensing provides digital remote-sensing data of several small study areas from various environments such as wetlands and volcanoes. *Recommended for:* Grades 7–12.

From a Distance: An Introduction to Remote Sensing/GIS/GPS

http://education.ssc.nasa.gov/ltp

This Web site was developed and is maintained by NASA John C. Stennis Space Center. It includes lesson plans on remote sensing for Grades K–3, 4–8, and 9–12 and links to related education resources. *Recommended for:* K–12.

GLOBE

http://globe.fsl.noaa.gov

Students from all over the world are participating in the Global Learning and Observations to Benefit the Environment (GLOBE) program by taking daily environmental measurements at their schools and sharing their data via the Internet. Some features on this Web site are specially designed and available only to GLOBE teachers and students who are trained in GLOBE measurement procedures. However, most features are available to anyone wanting to learn more about GLOBE, review the scientific areas of GLOBE study, read the GLOBE Teachers' Guide, and access student data. *Recommended for:* Elementary–high school.

Metropolitan East Coast (MEC) Assessment Educators Pack

http://metroeast_climate.ciesin.columbia.edu/edumod.html

The MEC assessment was one of 18 regional assessments of climate change and variability organized by the U.S. Global Change Research Program. The MEC Educator's Pack contains geographic information system (GIS) software, data sets, and lesson plans designed for educators who are interested in using GIS technology to explore global climate change issues. The package includes a free GIS software program called ArcExplorer by ESRI, the world's leading GIS software developer. ArcExplorer is easy to use and comes with a user manual to help get you started. Also provided are two lesson plans that use ArcExplorer to view the data and produce a series of maps to study climate change predictions in the MEC region. *Recommended for:* Middle–high school.

Mission Geography

http://missiongeography.org

Mission Geography is curriculum support materials that link the content, skills, and perspectives of Geography for Life: The National Geography Standards with the mis-

sions, research, and science of NASA. Developed by the Geography Education National Implementation Project (GENIP) at Texas A&M University. *Recommended for:* K–12.

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SkyMath: Mathematics for a Blue Planet

http://www.unidata.ucar.edu/staff/blynds/Skymath.html

The University Corporation for Atmospheric Research (UCAR) received funding from the National Science Foundation to prepare SkyMath, a set of middle school mathematics modules incorporating weather data. SkyMath requires teachers and students to acquire and use current environmental and real-time weather data in ways that embrace the dynamic and uncertain natures of these data, in order to promote the teaching and learning of significant mathematics, consistent with the standards set by the National Council of Teachers of Mathematics. The SkyMath modules may be freely downloaded from the Internet. *Recommended for:* Grades 5–8.

Students' Cloud Observations Online (S'COOL)

http://scool.larc.nasa.gov

S'COOL is a component of NASA's Clouds and the Earth's Radiant Energy System (CERES) project, which is providing global data on clouds. S'COOL participants make ground truth measurements for the CERES experiment, which are land-based observations to compare with satellite data for the purpose of improving the satellite results. The S'COOL Web site provides information on the project and how to participate, as well as classroom materials and resources. *Recommended for:* Grades 3–12.

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Searchable Web site with links to classroom materials and resources for teaching and learning about Earth system science. Users can search by grade level and subject. Developed by the Institute for Global Environmental Strategies. *Recommended for:* K–12.

Understanding the Biosphere from the Top Down

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This Web site contains a 22-lesson package written by eight local teachers working with the advice and help of NASA Ames Research Center personnel in Earth Sciences. The lessons focus on studying the biosphere from space to teach students about the Earth system. *Recommended for:* Grades 4–12.

Virtual Vacationland

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Virtual Vacationland is a resource tool to help elementary and secondary teachers and students find and use Earth science data and information on the Internet. Content is arranged by science topic. Each topic has a preview page that summarizes the material. Each topic also has 2 to 5 detail pages, which show where to access online data and what the data mean. The site includes over 40 hands-on activities available on the following science topics, with new topics being added as the site grows: Land Topography; Ocean Bathymetry; Coastal Tides; Ocean Buoy Data; Ocean Temperature; Weather and Climate; and Watersheds and Rivers. *Recommended for:* Elementary–secondary.

Visit to an Ocean Planet

http://topex-www.jpl.nasa.gov/education/cdrom.html
http://core.nasa.gov

Interactive, educational CD-ROM that reveals the importance of our oceans to global climate and life. Allows users to explore the Gulf of Mexico with satellite data, investigate the 1997–98 El Niño, discover "what's up" with Earth-orbiting satellites, and learn about the research activities of real life oceanographers. The curriculum background materials are arranged in the context of widely accepted teaching themes. The CD-ROM also highlights results from NASA's TOPEX/POSEIDON satellite. Available from NASA CORE. *Recommended for:* Grades 5–12.

76

Windows to the Universe

http://www.windows.ucar.edu

Windows to the Universe brings together scientific content on Earth and space sciences with interdisciplinary content on the arts and humanities, in order to provide a rich educational tool that satisfies the curiosity of a wide spectrum of learners as they seek to understand our world and space around us. Three levels of content are provided: students (K–12 through undergraduate), teachers, and browsing adults. The site includes a rich array of documents, images, movies, animations, sounds, games, and data that brings science to life for students, teachers, and the interested user. *Recommended for:* K–12, informal education.

World Watcher: Global Warming Project

http://www.worldwatcher.northwestern.edu

Global warming and its potential impact provide the context for this unit, in which students learn about the scientific factors contributing to the debate. Students act as advisors to the heads of state of several nations, and explore the issues as they respond to the various questions and concerns of these leaders. Activities include a combination of physical labs and investigations using World Watcher software, a geographic data visualization tool. Developed by Northwestern University. *Recommended audience:* Middle school+.

○ HIGH SCHOOL

Arctic Observatory/Sea Ice in the Polar Regions

http://core.nasa.gov

The Arctic Observatory includes a teacher's guide and interactively deals with Arctic phenomena and processes, allowing students to ask and answer questions about interrelationships between several physical aspects of the Arctic system. Sea Ice in the Polar Regions is a presentation that describes sea ice classification, observation and climate impacts. Both resources are available on one CD-ROM from NASA CORE; they can also be downloaded at: **http://www.usra.edu/esse/learnmod.html.** *Recommended for:* High school–adult.

Asian Monsoon CD-ROM

http://dao.gsfc.nasa.gov/sci_highlights/monsoon_cd
http://core.nasa.gov

This interactive, student-centered CD-ROM for studying global climate patterns focuses on the Asian monsoon season. Students are guided through an investigative journey studying weather and climate patterns and their effects on the local and world environments. *Recommended for:* High school.

CEOS Resources in Earth Observation

http://ceos.cnes.fr:8100/cdrom-98/astart.htm

The international Committee on Earth Observation Satellites (CEOS) has produced this CD/Web site, which contains case studies (examples of applications of Earth observation to various real-life situations and problems), data and information for education and developing countries. *Recommended for:* High school, undergraduate, graduate–professional.

Climate Change Presentation Kit, 1999

http://core.nasa.gov

This CD-ROM is offered as a resource to help prepare talks for students or the general public. The toolkit allows teachers the option of picking and choosing the components that they would need to communicate climate change issues to audiences. It contains fact sheets, a PowerPoint slide presentation, and interactive activities that are designed to interest audiences of all levels. Available from NASA CORE. *Level:* Elementary–college educators.

Data Discovery: The Amazon

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Earth & Sky

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Earth & Sky (E&S) and NASA's Earth Science Enterprise have collaborated on a series of 90-second radio programs highlighting ESE science, with scientists participating from Goddard Space Flight Center and Jet Propulsion Laboratory. The E&S radio series programs are produced for a measured audience of more than 3.8 million listeners (weekly). The E&S Web site contains links to the audio and text files for all E&S shows, as well as links to related educational resources. *Recommended for:* K–12 and informal education.

Earth Update

http://earth.rice.edu/connected/earthupdate.html
http://core.nasa.gov

Rice Space Institute developed this CD-ROM, which contains Earth science information, movies, and classroom activities. The CD is suitable as a stand-alone museum kiosk or for use in a school classroom or library. If the user's computer is connected to the Internet, today's data can be downloaded with a single click. Each "sphere" (Atmosphere, Biosphere, Cryosphere, Geosphere, and Hydrosphere) can be run separately or as the linked Earth Update. Each sphere includes sections What (What is the atmosphere), Who (Who studies the biosphere), Why (Why do we study the cryosphere?), and How (How do we study the geosphere?). Classroom activities aligned with national science, math, and geography standards are included on the CD. *Recommended for:* K–12 and informal education.

Exploring Earth from Space: Lithograph Set and Instructional Materials, LS-1999-05-001-HQ

http://spacelink.nasa.gov/products/Exploring.Earth.From.Space

Shuttle astronauts and the EarthKAM program provide photos of our planet from the unique perspective of Earth orbit. This resource can enhance your students' studies of Earth and space science, geography, social studies, mathematics, and educational technologies. The set contains an educators' guide, student information and worksheets, and several Earth photos taken from the Space Shuttle. *Recommended for:* Grades 3–12.

Exploring the Environment

http://www.cotf.edu/ete

Online, problem-based modules developed by NASA's Classroom of the Future for K–4, 5–8, and 9–12 teachers and students. Modules address events such as volcanoes, hurricanes, dinosaur extinction theories, deforestation, endangered species, and global change. *Recommended for:* K–12.

From a Distance: An Introduction to Remote Sensing/GIS/GPS

http://education.ssc.nasa.gov/ltp

This Web site was developed and is maintained by NASA John C. Stennis Space Center. It includes lesson plans on remote sensing for grades K–3, 4–8, and 9–12 that were developed by professional educators and links to related education resources. *Recommended for:* K–12.

Geomorphology from Space, 1986

http://daac.gsfc.nasa.gov/DAAC_DOCS/geomorphology/GEO_HOME_PAGE.html
http://core.nasa.gov

An out-of-print NASA classic publication, by Nick Short, Sr. and Robert W. Blair, Jr., is now available on CD-ROM and on the Web. This publication is designed for use by the remote-sensing science and educational communities to study landforms and landscapes. It contains a gallery of 237 color, and black and white plates of space imagery primarily of the Earth, each treating a geographic region where a particular landform theme is exemplified. Each image is paired with a detailed scientific description of the features in the image; some images are accompanied by line drawings, locator maps, geologic maps, and on-the-ground photographs of the landform. Available on the Web or on CD-ROM from NASA CORE. *Recommended for:* High school–adult.

Global Systems Science (GSS)

http://www.lhs.berkeley.edu/GSS

The GSS Student Books, developed at the Lawrence Hall of Science, can be combined in various ways to create an interdisciplinary high school course. In the GSS approach, students integrate the traditional disciplines to probe the interactions among the atmosphere, ocean, ice, solid Earth, and living organisms that shape Earth's evolution and its future. Students study the traditional disciplines, not as ends in themselves, but as tools for a scientific understanding of Earth as an integrated system. The following GSS books have been approved by NASA's Earth Science Enterprise:

- ☐ GSS Teachers' Guide
- ☐ New World View
- ☐ Climate Change
- ☐ Losing Biodiversity
- ☐ Energy Flow

Recommended for: Grades 9–12.

GLOBE Program

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Students from all over the world are participating in the Global Learning and Observations to Benefit the Environment (GLOBE) program by taking daily environmental measurements at their schools and sharing their data via the Internet. Some features on this Web site are specially designed and available only to GLOBE teachers and students who are trained in GLOBE measurement procedures. However, most features are available to anyone wanting to learn more about GLOBE, review the scientific areas of GLOBE study, read the GLOBE Teachers' Guide, and access student data. *Recommended for:* Elementary–high school.

Into the Arctic: Information and Education Activities for Studying Climate

http://arcss.colorado.edu/data/arcss069.html

The University of Colorado/CIRES developed this CD-ROM on climate and climate history in the Arctic, which uses real data and questions from the Greenland Ice Sheet Project Two (GISP2). *Recommended for:* Grades 9–12.

Mission Geography

http://missiongeography.org

Mission Geography is curriculum support materials that link the content, skills, and perspectives of Geography for Life: The National Geography Standards with the missions, research, and science of the National Aeronautics and Space Administration (NASA). Developed by the Geography Education National Implementation Project (GENIP) at Texas A&M University. *Recommended for:* K–12.

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Students' Cloud Observations Online (S'COOL)

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Studying Earth's Environment from Space

http://see.gsfc.nasa.gov/edu/SEES

This material consists of four modules: Stratospheric Ozone; Global Land Vegetation; Oceanography; and Polar Sea Ice Processes. The modules are designed to increase the use of satellite data in science classrooms by providing lecture materials in HTML for the classroom (including full-color, printable graphics) that are linked to guided-inquiry computer exercises. The current software package used for the computer exercises is a modified version of the Macintosh platform's NIH-Image. This software, called SEE Image, also has been tested and runs on a PC that is equipped with a Macintosh emulator. *Recommended for:* High school–undergraduate.

teachearth.com

http://teachearth.com

Searchable Web site with links to classroom materials and resources for teaching and learning about Earth system science. Users can search by grade level and subject. Developed by the Institute for Global Environmental Strategies. *Recommended for:* K–12.

Understanding the Biosphere from the Top Down

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Visit to an Ocean Planet

http://topex-www.jpl.nasa.gov/education/cdrom.html

1998, interactive, educational CD-ROM that reveals the importance of our oceans to global climate and life. Allows users to explore the Gulf of Mexico with satellite data, investigate the 1997–98 El Niño, discover "what's up" with Earth-orbiting satellites, and learn about the research activities of real life oceanographers. The curriculum background materials are arranged in the context of widely accepted teaching themes. The CD-ROM also highlights results from NASA's TOPEX/POSEIDON satellite. Available from NASA CORE (Item #400.0-92). *Recommended for:* Grades 5–12.

Windows to the Universe

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Windows to the Universe brings together scientific content on Earth and space sciences with interdisciplinary content on the arts and humanities, in order to provide a rich educational tool that satisfies the curiosity of a wide spectrum of learners as they seek to understand our world and space around us. Three levels of content are provided: students (K–12 through undergraduate), teachers, and browsing adults. The site includes a rich array of documents, images, movies, animations, sounds, games, and data that brings science to life for students, teachers, and the interested user. *Recommended for:* K–12, informal education.

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Global warming and it potential impact provide the context for this unit, in which students learn about the scientific factors contributing to the debate. Students act as advisors to the heads of state of several nations, and explore the issues as they respond to the various questions and concerns of these leaders. Activities include a combination of physical labs and investigations using World Watcher software, a geographic data visualization tool. Developed by Northwestern University. *Recommended audience:* Middle school+.

POSTSECONDARY

CERES—Clouds and the Earth's Radiant Energy System Brochure

http://eospso.gsfc.nasa.gov/eos_homepage/misc_html/ceres.html

This brochure gives a brief description of the science research that is being done with data from the CERES instrument flying onboard NASA's Terra satellite. It also contains some of the data products, as well as gives some technical specifications. *Recommended for:* Undergraduate, graduate, professional.

DAAC's Supporting Earth Observing Science Yearbook

http://nasadaacs.eos.nasa.gov/yearbooks/index.html

NASA's eight Distributed Active Archive Centers (DAAC) located across the U.S. deliver relevant, critical, and timely data that underpin crucial research and understanding of Earth. The DAACs distribute science data from both heritage and current NASA satellite missions that include NASA in-situ field campaigns and satellite missions flown by other U.S. Government agencies and international partners. Currently the DAACs provide data management support for over 900 science data sets that are routinely requested by members of the science research and educational communities, commercial entities, museums, and the general public. *Recommended for:* High school, undergraduate, graduate–professional.

Earth from Above: Using Color-Coded Satellite Images to Examine the Global Environment, 1997

http://www.uscibooks.com

Written by NASA Goddard Space Flight Center scientist Claire Parkinson, Earth from Above provides an easy introduction to understanding and interpreting satellite images. Beginning with two short chapters on visible satellite images and radiation, the book then covers six key Earth-atmosphere variables on such environmentally important topics as the Antarctic ozone hole, El Niño, deforestation, the missing carbon dilemma, and the effects of sea ice, snow cover, and volcanoes on atmospheric temperatures. A final chapter broadens the discussion to consider satellite Earth observations in general. Each section concludes with a list of questions; answers are provided at the back of the book. Available for purchase from University Science Books.

Earth System Science Online Courses for K–12 Teachers

http://www.cet.edu/essea

K–12 Earth system science (ESS) online graduate courses have been developed within the Center for Educational Technology (CET) at Wheeling Jesuit University for NASA's Earth Science Enterprise. The Earth system science courses use an innovative instructional design model, are delivered over the Internet, and feature student-centered, knowledge-building virtual communities. These courses are available for universities, colleges, and other science education training organizations to use. To view the courses, use "cet" as the user name and password.

Ecosystem Change and Public Health Textbook

http://www.press.jhu.edu/press/books/titles/s01/s01arec.htm

This textbook was published by Johns Hopkins University Press to: 1) raise awareness of changes in human health related to global ecosystem change; and 2) expand the scope of the traditional curriculum in environmental health to include the interactions of major environmental forces and public health on a global scale. The book covers such topics as global climate change, stratospheric ozone depletion, water resources management, and ecology and infectious disease. Case studies of cholera, malaria, the effects of water resources, and global climate change and air pollution illustrate the analysis and methodology. The book also includes a resource center describing places to start searches on the Web, guidelines for finding and evaluating information, suggested study projects, and strategies for encouraging communication among course participants. *Recommended for:* Undergraduate.

EOS Science Plan, 1999

http://eospso.gsfc.nasa.gov/sci_plan/chapters.html

Within this publication, the reader will find types and quality of data that will be produced from NASA Earth Observing System (EOS) satellite observations, how they will improve over existing measurements, and how the data will be applied to solving the problems described. Seven topical chapters discuss the nature of the science being reviewed: radiation, clouds, water vapor, precipitation, and atmospheric circulation; ocean circulation, productivity, and exchange with the atmosphere; greenhouse gases and atmospheric chemistry;

land ecosystems and hydrology; cryospheric systems; ozone and stratospheric chemistry; and volcanoes and climate effects of aerosols.

Geomorphology from Space, 1986

http://daac.gsfc.nasa.gov/DAAC_DOCS/geomorphology/GEO_HOME_PAGE.html
http://core.nasa.gov

An out-of-print NASA classic publication, by Nick Short, Sr. and Robert W. Blair, Jr., is now available on CD-ROM and on the Web. This publication is designed for use by the remote-sensing science and educational communities to study landforms and landscapes. It contains a gallery of 237 color, and black and white plates of space imagery primarily of the Earth, each treating a geographic region where a particular landform theme is exemplified. Each image is paired with a detailed scientific description of the features in the image; some images are accompanied by line drawings, locator maps, geologic maps, and on-the-ground photographs of the landform. Available on CD-ROM from NASA CORE. *Recommended for:* High school–adult.

Measurements of Pollution in the Troposphere (MOPITT) Brochure

http://eospso.gsfc.nasa.gov/eos_homepage/misc_html/mopitt.html

This brochure gives a brief description of the science research that is being done with data from the MOPPITT instrument flying onboard NASA's Terra satellite. It also contains some of the data products, as well as gives some technical specifications. *Recommended for:* Undergraduate, graduate–professionals.

Remote Sensing Core Curriculum

http://www.umbc.edu/rscc

The Remote Sensing Core Curriculum (RSCC), sponsored by the International Center for Remote Sensing Education (ICRSE), NASA, and the American Society for Photogrammetry and Remote Sensing (ASPRS) is an education program developed in cooperation with international experts and businesses to ensure an authoritative and substantive curriculum in remote sensing. The curriculum includes a series of lecture outlines, accompanied by self-contained laboratory exercises developed to support the advancing technologies of remote sensing and its integration with spatial information systems. Digital data sets from existing and planned satellite missions will enhance the understanding of advanced concepts. The RSCC design will ensure full access to data sets, operating software, and lecture materials via the RSCC home page.

The Remote Sensing Tutorial

http://rst.gsfc.nasa.gov

This CD-ROM is a tutorial approach to learning about the role of space science and technology in monitoring the Earth's surface and atmosphere. As you work through the tutorial, you will come to understand how remote sensing is applied to studying the land, sea, and air making up the environments of our planet. Not only will you gain insight into past uses of aerial photography and space imagery as records of the Earth's geography as well as the future plans for more advanced monitoring systems, but you should develop skills in interpreting these visual displays and data sets both by direct inspection and by computer processing. The CD-ROM, current as of early 1999, is available from NASA CORE. The latest version of the tutorial is available to download online from: **http://rst.gsfc.nasa.gov** *Recommended for:* College and remote-sensing professionals.

Studying Earth's Environment from Space

http://see.gsfc.nasa.gov/edu/SEES

This material consists of four modules: Stratospheric Ozone; Global Land Vegetation; Oceanography; and Polar Sea Ice Processes. The modules are designed to increase the use of satellite data in science classrooms by providing lecture materials in HTML for the classroom (including full-color, printable graphics) that are linked to guided-inquiry computer exercises. The current software package used for the computer exercises is a modified version of the Macintosh platform's NIH-Image. This software, called SEE Image, also has been tested and runs on a PC that is equipped with a Macintosh emulator. *Recommended for:* High school–undergraduate.

World Watcher: Global Warming Project

http://www.worldwatcher.northwestern.edu

Global warming and its potential impact provide the context for this unit, in which students learn about the scientific factors contributing to the debate. Students act as advisors to the heads of state of several nations, and explore the issues as they respond to the various questions and concerns of these leaders. Activities include a combination of physical labs and investigations using World Watcher software, a geographic data visualization tool. Developed by Northwestern University. *Recommended audience:* Middle school+.

82

INFORMAL EDUCATION

Earth Observatory

http://earthobservatory.nasa.gov

Web site where the public can obtain new satellite imagery and scientific information about Earth, focusing on climate and environmental change. Visit the Earth Observatory to read feature articles on wide-ranging Earth system science topics, as well as see the latest images, media alerts, and summaries of Earth science headlines from radio, newspaper, and television. The Experiments section includes classroom activities and experiments.

Earth & Sky

http://earthsky.com

Earth & Sky (E&S) and NASA's Earth Science Enterprise have collaborated on a series of 90-second radio programs highlighting ESE science, with scientists participating from Goddard Space Flight Center and Jet Propulsion Laboratory. The E&S radio series programs are produced for a measured audience of more than 3.8 million listeners (weekly). The E&S Web site contains links to the audio and text files for all E&S shows, as well as links to related educational resources. *Recommended for:* K–12 and informal education.

Earth Update

http://earth.rice.edu/connected/earthupdate.html
http://core.nasa.gov

Rice Space Institute developed this CD-ROM, which contains Earth science information, movies, and classroom activities. The CD is suitable as a stand-alone museum kiosk or for use in a school classroom or library. If the user's computer is connected to the Internet, today's data can be downloaded with a single click. Each "sphere" (Atmosphere, Biosphere, Cryosphere, Geosphere, and Hydrosphere) can be run separately or as the linked Earth Update. Each sphere includes sections What (What is the atmosphere), Who (Who studies the biosphere), Why (Why do we study the cryosphere?), and How (How do we study the geosphere?). Classroom activities aligned with national science, math, and geography standards are included on the CD. Also available from NASA CORE. *Recommended for:* K–12 and informal education.

NASA's Earth Observing System—Global Change Media Directory 2001

http://dougb.gsfc.nasa.gov:591/eobsearch.html

This publication contains an alphabetical list of NASA Earth Observing System researchers, with contact information, and their areas of expertise. It also contains indices for areas of expertise, location, as well as media resources and public affairs contacts. Online Version is titled: Global Change Experts Directory. *Recommended for:* Broadcast and print media; also useful for formal and informal education product developers (e.g., references for information).

Science Writers Guide to Landsat-7

http://landsat.gsfc.nasa.gov/main/PDF/Landsat7_writer_guide.pdf

Landsat 7 is advancing several areas of Earth science, including monitoring croplands and mapping Antarctic ice streams. This guide profiles several Landsat 7 research projects and provides background and contact information. *Recommended for:* Science writers/media.

Science Writers Guide to Terra

http://earthobservatory.nasa.gov/Newsroom/MediaResources/Terra_Writers_Guide.pdf

The launch of NASA's Terra spacecraft marked a new era of comprehensive monitoring of the Earth's atmosphere, oceans, and continents from a single space-based platform. Data from the 5 Terra instruments are creating continuous, long-term records of the state of the land, oceans, and atmosphere. Together with data from other satellite systems launched by NASA and other countries, Terra will inaugurate a new self-consistent data record that will be gathered over the next 15 years. This guide provides research profiles, as well as extensive background and contact information for Terra. *Recommended for:* Science writers/media.

Space Place

http://spaceplace.jpl.nasa.gov

NASA Jet Propulsion Laboratory Web site geared for elementary age children. The site provides fun activities for children to do and make, while they learn about space and Earth science, and the technology that enables science. The"Teachers Corner" on the Web site contains curriculum supplements originally published in the ITEAS' Technology Transfer Teacher magazine. *Recommended for:* Elementary-age children.

Visible Earth

http://visibleearth.nasa.gov

This companion site to the NASA Earth Observatory is a comprehensive image gallery for access to NASA Earth science images, animations, and data visualizations. Most resources are available digitally at multiple resolutions, with captions and metadata. All resources are full-text search-and-retrievable. *Recommended for:* General audiences.

Windows to the Universe

http://www.windows.ucar.edu

Windows to the Universe brings together scientific content on Earth and space sciences with interdisciplinary content on the arts and humanities, in order to provide a rich educational tool that satisfies the curiosity of a wide spectrum of learners as they seek to understand our world and space around us. Three levels of content are provided: students (K–12 through undergraduate), teachers, and browsing adults. The site includes a rich array of documents, images, movies, animations, sounds, games, and data that brings science to life for students, teachers, and the interested user. *Recommended for:* K–12, informal education.

EDUCATIONAL RESOURCES

The following resources can be useful for developing lesson plans, curriculum supplements, student research projects, and sources of NASA research information and imagery.

BOOKMARKS

Climate Change Bookmarks

Set of bookmarks developed by NASA Langley Research Center, including: Ozone; Biomass Burning, Volcanic Aerosols, Clouds, and Human and Natural Impacts on the Earth. Each bookmark provides a Web address for additional information. Available online at: **http://asd-www.larc.nasa.gov/ASDhomepage.html**

LITHOGRAPHS

Lithographs contain a color image (e.g., satellite image, artist's rendition of a spacecraft or instrument, etc.), with additional information and classroom activities or discussion questions. The following lithographs are available to download from NASA Spacelink: **http://spacelink.nasa.gov/products** or from your local NASA Educator Resource Center:

http://spacelink.nasa.gov/ercn

- ☐ *1997–1998 El Niño Lithograph* (LG-1998-05-004-GSFC)
- ☐ *Exploring Earth from Space* (LS-1999-05-001-HQ)
- ☐ *First Image of the Global Biosphere* (Hql-325)
- ☐ *Understanding Our Changing Planet* (HqL-430)
- ☐ *Water is a Force of Change* (Hql-401)
- ☐ *World Cloud Cover Pattern* (HqL-326)

BROCHURES

NASA's Earth Observing System: Terra Spacecraft

http://eospso.gsfc.nasa.gov/ftp_docs/Terra_brochure.pdf

This brochure gives a brief overview of the Earth science research that is being done with data from the instruments onboard NASA's Terra spacecraft.

NASA EARTH SCIENCE ENTERPRISE SCIENCE WRITING AND MULTIMEDIA TEAM

This team of science writers, science visualization professionals, and scientific illustrators examines NASA-conducted and sponsored Earth system science research for stories of broad appeal and interest to the public. They craft stories, create visual aids, and make the information and products available to the media and other parties. Archived stories, many of which have accompanying graphics, can be found at **http://newsmedia.gsfc.nasa.gov.** A searchable video catalog is available at the Goddard TV Web site **http://www.gsfc.nasa.gov/gtv.html**, and a gallery and searchable catalog of visualizations are available at **http://newsmedia.gsfc.nasa.gov**

CONTACT: Jim Closs, NASA Goddard Space Flight Center, *Phone:* 301-867-2116, Fax: 301-867-2149, *Email:* jim.closs@gsfc.nasa.gov—or: Anita Davis, Earth Science Enterprise Education Implementation Office, Goddard Space Flight Center, *Phone:* 301-286-8591, *Email:* adavis@see.gsfc.nasa.gov

NASA EARTH SCIENCE MISSIONS–EDUCATION

Many of NASA's Earth Science Missions have an education and public outreach component. These efforts include a wide variety of educational activities and resources for educators, students, and the public, such as teacher workshops, student activities, and public programs and events, as well as curriculum and classroom materials, and resources such as CD-

ROMs, posters, brochures, and videos. Visit the individual Web sites identified below for specific information on their programs and resources, including access to satellite imagery and other data. Missions are listed by year of launch.

☐ **TOPEX/Poseidon**
http://sealevel.jpl.nasa.gov

Jointly sponsored by NASA and the French Space Agency (CNES) the TOPEX/Poseidon satellite has used a radar altimeter to continuously survey ocean surface height since launch in 1992. TOPEX/Poseidon has been joined in orbit by its follow-on mission, Jason-1, which was launched in 2001.

Scientists are using TOPEX/Poseidon and Jason-1 data, accurate to within 4 cm, to learn more about global ocean circulation patterns including phenomena such as the El Niño/La Niña cycle. Oceans are a key mechanism in transporting heat from the Sun around the globe. Researchers are working to improve the understanding of the role of oceans in controlling seasonal variations and longer-term climate changes. Ocean altimetry data are also used for operational purposes including ship routing, fisheries management, hurricane forecasting, and support of underwater activities such as cable laying. CONTACT: Annie Richardson, Jet Propulsion Laboratory; topex@jpl.nasa.gov (1992 Launch)

☐ **SeaWiFS**
http://seawifs.gsfc.nasa.gov/SEAWIFS.html

The Sea-viewing Wide Field-of-view Sensor (SeaWiFS) is providing quantitative data on global ocean bio-optical properties. Subtle changes in ocean color signify various types and quantities of marine phytoplankton (microscopic marine plants), the knowledge of which has both scientific and practical applications. (1997 Launch)

☐ **Tropical Rainfall Measuring Mission (TRMM)**
http://trmm.gsfc.nasa.gov—*click on link for "Educational Resources"*

TRMM is a joint mission between NASA and the National Space Development Agency (NASDA) of Japan. It was designed to monitor and study tropical rainfall and the associated release of energy that helps to power the global atmospheric circulation shaping both weather and climate around the globe. CONTACT: Alan Nelson, Education Coordinator, NASA Tropical Rainfall Measuring Mission (TRMM), Education Department, Science Museum of Minnesota, 120 West Kellogg Boulevard, St. Paul, Minnesota 55102; anelson@smm.org (1997 Launch)

☐ **ACRIMSAT**
http://www.acrim.com

A series of Active Cavity Radiometer Irradiance Monitors (ACRIMs) provides long-term, precise measurements of the total amount of the sun's energy that falls on our planet's surface, oceans, and atmosphere. (1999 Launch)

☐ **Landsat-7**
http://landsat.gsfc.nasa.gov/main/education.html

The Landsat-7 satellite is acquiring remotely-sensed images of land surface and coastal regions for global change research, regional environmental change studies, national security uses, and other civil and commercial purposes. The Landsat-7 data set will provide the first high-resolution view of both seasonal and interannual changes in the terrestrial environment. CONTACT: Stephanie Stockman, NASA Goddard Space Flight Center; stockman@core2.gsfc.nasa.gov (1999 Launch)

☐ **QuikScat/SeaWinds**
http://winds.jpl.nasa.gov/missions/quikscat/quikindex.html

The SeaWinds instrument on the QuikScat mission is a "quick recovery" mission to fill the gap created by the loss of data from the NASA Scatterometer (NSCAT), when the satellite lost power in June 1997. The SeaWinds instrument is a specialized microwave radar that measures near-surface wind speed and direction under all weather and cloud conditions over the Earth's oceans. (1999 Launch)

☐ **Terra**
http://terra.nasa.gov

Terra, the flagship of NASA's Earth Observing System, is collecting what will ultimately become a new, 15-year global data set on the state of the land, oceans, and atmosphere. CONTACT: David Herring, NASA Goddard Space Flight Center; dherring@climate.gsfc.nasa.gov (1999 Launch)

☐ **EO-1**
http://eo1.gsfc.nasa.gov

Earth Observing-1 (EO-1) is the first flight of NASA's New Millennium Program (NMP). Its mission is to validate technologies that will contribute to the reduction in cost of follow-on Landsat missions. (2000 Launch)

☐ **Jason-1**
http://sealevel.jpl.nasa.gov

The follow-on mission to TOPEX/Poseidon, scientists are using Jason-1 data to learn more about global ocean circulation patterns including phenomena such

as the El Niño/La Niña cycle. See TOPEX/Poseidon, 1992 listing on page 77 for additional details. (2001 Launch)

☐ **METEOR 3M-1/SAGE III**
http://www-sage3.larc.nasa.gov

The SAGE III mission on the Russian Meteor 3M-1 spacecraft seeks to enhance our understanding of natural and human-derived atmospheric processes by providing high latitude long-term measurements of the vertical structure of aerosols, ozone, water vapor, and other important trace gases in the upper troposphere and stratosphere. (2001 Launch)

☐ **Aqua**
http://aqua.nasa.gov

Aqua, Latin for "water," is named for the large amount of information the mission will be collecting about the Earth's water cycle, including evaporation from the oceans, water vapor in the atmosphere, clouds, precipitation, soil moisture, sea ice, land ice, and snow cover on the land and ice. Additional variables measured by Aqua are radiative energy fluxes, aerosols, vegetation cover on the land, phytoplankton and dissolved organic matter in the oceans, and air, land, and water temperatures. CONTACT: Steve Graham, NASA Goddard Space Flight Center; graham@pop900.gsfc.nasa.gov (2002 Launch)

☐ **GRACE**
http://essp.gsfc.nasa.gov/grace/index.html

The second of the Pathfinder missions, the Gravity Recovery and Climate Experiment (GRACE) employs a satellite-to-satellite microwave tracking system between two spacecraft to measure the Earth's gravity field and its time variability over five years. Such measurements are directly coupled to long-wavelength ocean circulation processes and to the transport of ocean heat to the Earth's poles. (2002 Launch)

☐ **ICESat**
http://icesat.gsfc.nasa.gov—*click on link for "Public Outreach"*

The Ice, Cloud, and Land Elevation Satellite (ICESat) is a small satellite mission to fly the Geoscience Laser Altimeter System (GLAS). GLAS will accurately measure the elevation of the Earth's ice sheets, clouds, and land. (2002 Launch)

☐ **SORCE**
http://lasp.colorado.edu/sorce

The Solar Radiation and Climate Experiment (SORCE) will provide scientists with long-term, accurate measurements of the solar ultraviolet (UV), far ultraviolet (FUV), and total irradiance from the sun. (2002 Launch)

☐ **SeaWinds on ADEOS II**
http://winds.jpl.nasa.gov/missions/seawinds/seaindex.html

The Advanced Earth Observing Satellite II (ADEOS II), is a joint mission with the National Space Development Agency (NASDA) of Japan. The SeaWinds scatterometer is a specialized microwave radar that measures near-surface wind velocity (both speed and direction) under all weather and cloud conditions over Earth's oceans. (2002 Launch)

☐ **Aura**
http://aura.gsfc.nasa.gov—*click on link for "Outreach"*

Aura will study the Earth's ozone, air quality and climate. This mission is designed exclusively to conduct research on the composition, chemistry and dynamics of the Earth's upper and lower atmosphere employing multiple instruments on a single satellite. CONTACT: Stephanie Stockman, NASA Goddard Space Flight Center; stockman@core2.gsfc.nasa.gov (2003 Launch)

☐ **CALIPSO**
http://essp.gsfc.nasa.gov/calipso/index.html

CALIPSO (Cloud Aerosol Lidar and Infrared Pathfinder Satellite Observations) will improve our understanding of the role of aerosols and clouds in the processes that govern climate responses and feedbacks, and improve the representation of aerosols and clouds in models, leading to more accurate predictions of climate change. It will produce the first 3-dimensional view of aerosols and cloud profiles complementary to those of CloudSAT. CONTACT: Dianne Robinson, Public Outreach Director for CALIPSO, Hampton University; dianne.robinson@hamptonu.edu—or: Barbara Maggi, Public Outreach, Assistant Director for CALIPSO, Hampton University; barbara.maggi@hamptonu.edu (2004 Launch)

☐ **CloudSAT**
http://cloudsat.atmos.colostate.edu/—*click on link for "Outreach"*

CloudSat will provide vertical cloud profiling from space of the full range of clouds from thin cirrus to thick, precipitating convective clouds. It will also provide the first quantitative estimates of ice in clouds. The mission will fill a critical gap in the investigation of feedback mechanisms linking clouds to climate. CloudSat will orbit in formation as part of a constellation of satellites including Aqua, Aura, and CALIPSO. A unique feature that CloudSat brings to this constellation is the ability to fly a precise orbit,

86

enabling the footprint of CloudSat radar to be overlapped with the CALIPSO lidar footprint, as well as the other measurements of the constellation. The precision of this overlap creates a unique multi-satellite observing system for studying the atmospheric processes essential to the hydrological cycle. CONTACT: Debra Krumm, Outreach Coordinator, Department of Atmospheric Science, Colorado State University, Fort Collins, CO 80523-1371; *Email:* dkrumm@atmos.colostate.edu (2004 Launch)

☐ **GIFTS**
http://tellus.ssec.wisc.edu/outreach/gifts/gifts.htm

The Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS) will make revolutionary advances in weather observations and potentially improve weather forecast skills considerably by making high vertical and horizontal measurements of winds, water vapor, and temperature in the Earth's atmosphere from a geosynchronous altitude (36,000 km above the Earth's surface). CONTACT: Arlene Levine, NASA Langley Research Center, a.s.levine@express.larc.nasa.gov (2004 Launch)

NASA FACTS

NASA Facts are educational brochures that provide general information and background on NASA-related missions, research topics, and activities. The following Earth science NASA Facts are available online at:
http://eospso.gsfc.nasa.gov/eos_homepage/misc_html/nasa_facts.html

☐ *Clouds and the Energy Cycle*—NF-207, August 1999

☐ *El Niño*—NF-211, August 1999

☐ *Global Warming*—NF-222, April 1998

☐ *NASA Earth Science Enterprise Images and Video via the World Wide Web*—FS-1998-02-007-GSFC, November 1998

☐ *Polar Ice*—NF-212, April 1998

☐ *Tropical Deforestation*—FS-1998-11-120-GSFC, November 1998

NEWSLETTER

Earth Science Enterprise Education Update

A free, monthly email newsletter, which contains information on NASA Earth science education activities, research announcements, current science news, and calendar of upcoming education events. To subscribe, please send email to: ese_ed_newsletter@listserv.gsfc.nasa.gov. Back issues are available at: **http://www.earth.nasa.gov/education/edreports/index.html**

POSTERS

From the Top of the World to the Bottom of the Food Web

http://www.bigelow.org/foodweb

This educational wall sheet and associated Web site were developed by Bigelow Laboratory for Ocean Sciences to help teachers and students discover linkages among marine ecology, phytoplankton, the behavior of light at the ocean surface, and satellite derived ocean color data. *Recommended for:* Middle school+ .

Rise and Fall of the 97–98 El Niño as Tracked by the TOPEX/POSEIDON

EW-1998-11-004-JPL
http://topex-www.jpl.nasa.gov/education/el-nino-poster.html

Color satellite images from NASA's TOPEX/POSEIDON mission illustrate this poster, which tracks the 1997–98 El Niño. The reverse side of the poster contains black and white, reproducible pages with information and classroom activities. Information and classroom activities contained on the poster are available in PDF format at the Web site listed above.

SeaWiFS Poster with Teaching Supplement

http://seawifs.gsfc.nasa.gov/SEAWIFS/TEACHERS

Poster with remote-sensing images from NASA's Sea-viewing Wide Field-of-View Sensor (SeaWiFS). The teaching supplement augments the poster with descriptive summaries of the variety of geophysical phenomena that can be seen in each image. The supplement also includes a glossary of terms and a listing of URLs for additional information. *Recommended for:* Upper high school–undergraduate

VIDEOTAPES

The following are selected videotapes related to NASA's Earth Science Program, which are available for purchase from NASA CORE at:
http://core.nasa.gov

Catch the Wind: the QuikSCAT Video, 2001

Video that tells the story from inception to launch of NASA's quick scatterometer project (QuikSCAT), which gives a behind-the-scenes look at engineers, scientists, and technicians working together to solve problems and successfully accomplish goals. Length: 25:22. *Recommended for:* Middle school–adult.

NASA Connect: Data Analysis, and Measurement—Ahead, Above the Clouds, 2001

NASA CONNECT is a series of free, 30-minute, standards-based instructional distance learning programs for students in grades 5–8. Each program is accompanied by an educators' guide describing a hands-on classroom activity, and a Web-based component that reinforces the learning objectives and extends the lesson into a technology-rich environment. In "Ahead, Above the Clouds" students learn about hurricanes and how meteorologists, weather officers, and NASA researchers use measurement and data analysis to predict severe weather such as hurricanes. Length: 30:00. *Recommended for:* Middle school.

Glacier Bay, Alaska, From the Ground, Air and Space, 1996

Brings glaciers to life with nine spectacular "fly-bys" of scenic rides over 3-dimensional glaciers, live video footage of ice fronts calving into the sea, and dramatic picture sequences of historical and satellite data, and shows how a NASA glaciologist has learned about glaciers and how their formation could be related to climate change. In addition to NASA CORE, this video is also available online at: **http://sdcd.gsfc.nasa.gov/GLACIER.BAY/glacierbay.story.html**. Length: 13:15. *Recommended for:* Grade 5–adult.

Jason: An Ocean Odyssey Video, 2001

Jason is joint U.S.-France oceanography mission to monitor global ocean circulation, discover the tie between the oceans and atmosphere, improve global climate predictions, and monitor events such as El Niño conditions and ocean eddies. Jason-1 is a follow-on mission to the highly successful TOPEX/Poseidon mission. Length: 9:00. *Recommended for:* Grade 5–adult.

SunSplash, 1997

Explains ozone depletion, using computer graphics and animation. The educational narrative explains how ozone in the stratosphere protects us from ultraviolet radiation and demonstrates how chlorofluorocarbons (CFCs) cause destruction of the Earth's protective ozone layer. Length: 7:52. *Recommended for:* Grades 9–12.

UARS—The Upper Atmosphere Research Satellite Video and Resource Guide, 2001

This videotape was created to be a resource for helping to understand stratospheric ozone. The instruments aboard the UARS and their measurements are described in the tape and how they help in studying humankind's influence on ozone. *Recommended for:* High school–undergraduate.

WEB SITES

Astronaut Photos of Earth

http://eol.jsc.nasa.gov

The Earth Science home page provides access to the database of the Office of Earth Science/Johnson Space Center containing records of the location and description of over 350,000 astronaut photographs of the Earth. Other features include image highlights from shuttle missions and from the Shuttle/Mir missions. Internet guests may also view Space Shuttle orbit track maps and calculate shuttle positions when specific times are entered into the program.

Destination Earth: The Official Web Site for NASA's Earth Science Enterprise

http://www.earth.nasa.gov

This site should be your starting point for learning about NASA's Earth Science Enterprise (ESE). Includes current ESE news and events, sections on education for teachers and students, and information on current research opportunities. Many links to other information resources are also included.

Earth Observatory

http://earthobservatory.nasa.gov

Web site where the public can obtain new satellite imagery and scientific information about Earth, focusing on climate and environmental change. Visit the Earth Observatory to read feature articles on wide-ranging Earth system science topics, as well as see the latest images, media alerts, and summaries of Earth science headlines from radio, newspaper, and television. The Experiments section includes classroom activities and experiments.

Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAAC)

EOSDIS is an integral part of NASA Earth Observing System. It is the robust distributed system that processes, archives, and manages Earth science satellite and field data, and distributes these data to a diverse global user community. Science data products (including over 700 from missions preceding EOS) are available from the DAACs, with each DAAC responsible for distributing data from specific disciplines. All data products are fully supported with documentation and technical user support.

☐ **Alaska SAR Facility**
http://www.asf.alaska.edu
Disciplines: Sea ice, polar processor imagery, synthetic aperature radar (SAR) .

☐ **Earth Resources Observation System (EROS) Data Center (EDC) Land Processes DAAC**
http://edcdaac.usgs.gov/main.html
Disciplines: Land processes .

☐ **Goddard Space Flight Center (GSFC) DAAC**
http://daac.gsfc.nasa.gov
Disciplines: Upper atmosphere, atmospheric dynamics, global biosphere, geophysics.

☐ **Langley Research Center (LARC) DAAC**
http://eosweb.larc.nasa.gov
Disciplines: Radiation budget, clouds, aerosols, tropospheric chemistry.

☐ **National Snow and Ice Data Center (NSIDC)**
http://www-nsidc.colorado.edu
Disciplines: Snow and ice, cryosphere and climate.

☐ **Physical Oceanography Distributed Active Archive Center (DAAC)**
http://podaac.jpl.nasa.gov
Disciplines: Ocean circulation and air-sea interaction.

☐ **Oak Ridge National Laboratory (ORNL) DAAC**
http://www-eosdis.ornl.gov
Disciplines: Biogeochemical dynamics.

☐ **Socio-Economic Data and Applications Center (SEDAC)**
http://sedac.ciesin.org
Disciplines: Socio-economic data related to global change.

AFFILIATED DATA CENTERS

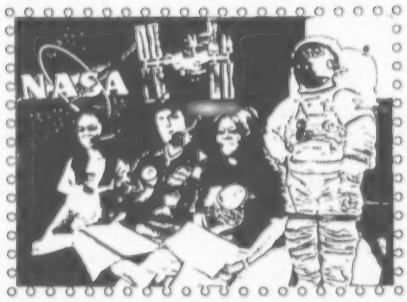
☐ **National Oceanic and Atmospheric Administration Satellite Active Archive (NOAA-SAA)**
http://www.saa.noaa.gov
Disciplines: Satellite data-atmosphere, land, oceans, Earth science, remote sensing.

☐ **Global Hydrology and Climate Center**
http://www.ghcc.msfc.nasa.gov
Disciplines: Earth's global water cycle, the distribution and variability of atmospheric water, and the impact of human activity as it relates to global and regional climate.

EOS Project Science Office
http://eospso.gsfc.nasa.gov
The EOS Project Science Office produces a Web site which allows the user to discover, retrieve, and display EOS and Earth science resources, including documents and reports, calendar of events, images, slides, fact sheets, posters, CD-ROMs, etc.

PUMAS (Practical Uses of Math and Science)
PUMAS is the online journal of one-page examples illustrating how math and science concepts are actually used in everyday life. PUMAS examples may be activities, anecdotes, descriptions of neat ideas, formal exercises, puzzles, or demonstrations, written primarily by scientists. They are intended mainly to help K–12 teachers enrich their presentation of science and math in the classroom. Teachers can search the PUMAS collection based on curriculum topic, grade level, and subject. They can select relevant examples, and develop ideas of their own about how to integrate the material into their lesson plans.
Recommended for: K–12 Teachers.

NASA Resources for Educators



Educator Resource Center Network (ERCN)

NASA Educator Resource Centers are located on or near NASA Field Centers, museums, colleges, or other nonprofit organizations. The ERCNs provide educators with in-service and pre-service training, demonstrations, and access to NASA instructional products. A listing of NASA ERCs at . 'ASA Field Centers, and the states they serve, is provided below. A complete listing of NASA ERCs in every state is available at: **http://spacelink.nasa.gov/ercn**

NASA Field Center Educator Resource Centers

Alaska, Northern California (southernmost counties of Inyo, Kings, Monterey, Tulare), Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming

NASA Ames Research Center
NASA Educator Resource Center
Mail Stop 253-2
Moffett Field, CA 94035-1000
Phone: 650-604-3574
Fax: 650-604-3445
http://amesnews.arc.nasa.gov/erc/erchome.html

Arizona, Southern California (northernmost counties of Kern, San Bernardino, San Luis Obispo)

NASA Educator Resource Center for NASA Dryden Flight Research Center
45108 North Third Street East
Lancaster, CA 93535
Phone: 661-948-7347
Toll-Free: 1-866-302-5840
Fax: 661-948-7068
http://www.dfrc.nasa.gov/trc/ERC

California

NASA Educator Resource Center for NASA Jet Propulsion Laboratory
Village at Indian Hill
1460 East Holt Ave., Suite 20
Pomona, CA 91767
Phone: 909-397-4420
Fax: 909-397-4470
http://learn.jpl.nasa.gov/resources/resources_index.html

Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin

NASA Glenn Research Center
NASA Educator Resource Center
21000 Brookpark Rd., MS 8-1
Cleveland, OH 44135
Phone: 216-433-2017
Fax: 216-433-3601
http://www.grc.nasa.gov/WWW/PAO/html/edteachr.htm

Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont

NASA Goddard Space Flight Center
NASA Educator Resource Center
Mail Code 130.3
Greenbelt, MD 20771
Phone: 301-286-8570
Fax: 301-286-1781
http://www.gsfc.nasa.gov/vc/erc.htm

Virginia's and Maryland's Eastern Shores

GSFC/Wallops Flight Facility
NASA Educator Resource Center
Building J-17
Wallops Island, VA 23337
Phone: 757-824-2298
Fax: 757-824-1776
http://www.wff.nasa.gov/~WVC/ERC.htm

Colorado, Kansas, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas

NASA Educator Resource Center for NASA Johnson Space Center
Space Center Houston
1601 NASA Road One
Houston, TX 77058
Phone: 281-244-2129
Fax: 281-483-9638
http://www.spacecenter.org/educator_resource.html

Florida, Georgia, Puerto Rico, Virgin Islands

NASA Kennedy Space Center
NASA Educator Resource Center
Mail Code ERC
J.F. Kennedy Space Center, FL 32899
Phone: 321-867-4090
Fax: 321-867-7242
http://www-pao.ksc.nasa.gov/kscpao/educate/teacher.htm#educate

Kentucky, North Carolina, South Carolina, Virginia, West Virginia

NASA Educator Resource Center for NASA Langley Research Center
Virginia Air and Space Center

600 Settlers Landing Road
Hampton, VA 23669-4033
Phone: 757-727-0900, ext. 757
Fax: 757-727-0898
http://www.vasc.org/erc

Alabama, Arkansas, Iowa, Louisiana, Missouri, Tennessee

NASA Educator Resource Center for NASA Marshall Space Flight Center
U.S. Space & Rocket Center
One Tranquility Base
Huntsville, AL 35807
Phone: 256-544-5812
Fax: 256-544-5820
http://erc.msfc.nasa.gov

Mississippi

NASA Stennis Space Center NASA Educator Resource Center
Building 1200
Stennis Space Center, MS 39529-6000
Phone: 228-688-3338
Toll-Free: 1-800-237-1821
Fax: 228-688-2824
http://education.ssc.nasa.gov/erc/erc.htm

○ **NASA's Central Operation of Resources for Educators (CORE)** is a worldwide distribution center for NASA's educational multimedia. For a minimal fee, NASA CORE will provide educators with materials through its mail order service.

Educational materials available include videotape programs, slide sets, computer software, and CD-ROMS. These materials are designed to supplement classroom instruction and increase awareness and understanding of NASA's scientific research and technology and provide a historical account of NASA's accomplishments.

NASA CORE is a nonprofit organization jointly sponsored by NASA and the Lorain County Joint Vocational School in Oberlin, Ohio. Educators may request a catalog and order form by writing, calling, faxing, or emailing:

NASA CORE
Lorain County JVS
15181 Route 58 South
Oberlin, OH 44074
Phone: 866-776-CORE (2673)
Fax: 866-775-1460
Toll-Free Ordering: 1-866-776-CORE
Toll-Free Fax: 1-866-775-1460
Email: nasaco@leeca.org
http://education.nasa.gov/core

○ **NASA's Education Home Page** serves as a cyber-gateway to information regarding educational programs and services offered by NASA for the American education community. This high-level directory of information provides specific details and points of contact for all of NASA's educational efforts, Field Center offices, and points of presence within each state. Visit this resource at the following address:
http://education.nasa.gov

○ **NASA Spacelink** is one of NASA's electronic resources specifically developed for the educational community. Spacelink is a "virtual library" in which local files and hundreds of NASA Web links are arranged in a manner familiar to educators. Using the Spacelink search engine, educators can search this virtual library to find information regardless of its location within NASA. Special events, missions, and intriguing NASA Web sites are featured in Spacelink's "Hot Topics" and "Cool Picks" areas. Spacelink may be accessed at:
http://spacelink.nasa.gov

NASA Spacelink is the official home to electronic versions of NASA's Educational Products. A complete listing of NASA Educational Products can be found at the following address:
http://spacelink.nasa.gov/products

○ **NASA Television (NTV)** features Space Shuttle mission coverage, live special events, interactive educational live shows, electronic field trips, aviation, space news, and historical NASA footage. Programming has a three-hour block—Video (News) File, NASA Gallery, and Education File beginning at noon EST and repeated three more times throughout the day.

The NASA Education File features programming for educators and students highlighting science, mathematics, geography, and technology-related topics. Viewers are encouraged to tape the programs. The NTV Education File is at **http://spacelink.nasa.gov/education.file**

Via satellite—GE2 Satellite, Transponder 9C at 85 degrees West longitude, vertical polarization, with a frequency of 3880.0 megahertz (MHz) and audio of 6.8 MHz—or through collaborating distance learning networks and local cable providers. Please visit **http://www.nasa.gov/ntv/ntvweb.html** to learn about NTV on the Web.

○ **National Space Grant College and Fellowship Program**

The National Space Grant College and Fellowship Program contributes to the Nation's science enterprise by funding research, education, and public service projects through a national network of 52 university-based Space Grant consortia.

Additional information about the Space Grant College and Fellowship Program, including links to the Space Grant in your state, can be found at NASA's Space Grant Home Page:
http://www.hq.nasa.gov/spacegrant

Index

1997–1998 El Niño Lithograph (LG-1998-05-004-GSFC) 76

Access Earth 2, 19, 31

ACRIMSAT 37, 77

The Adventure of Echo the Bat 65

The Adventure of Echo the Bat Pop-up Book 63

Aeronautics and Earth Science Academy 2–3

Alaska Alliance for Earth System Science Education 19–20, 52

Alaska SAR Facility 81

Ames Aerospace Encounter 3

Aqua 37, 78

Arctic Observatory/Sea Ice in the Polar Regions 69

Asian Monsoon CD-ROM 69

Astronaut Photos of Earth 80

Aura 38, 78

Bookmarks 76

CALIPSO 38, 78

Catch the Wind: the QuikSCAT Video, 2001 79

Center for Hydrology, Soil Climatology, and Remote Sensing's Undergraduate Summer Enrichment Program . . 10

Center for the Study of Terrestrial and Extraterrestrial Atmospheres (CSTEA) 10

Central Operation of Resources for Educators (CORE) 83

CEOS Resources in Earth Observation 69

CERES—Clouds and the Earth's Radiant Energy System Brochure 73

Certificate and Master's Degree Program in Earth/Space Science for Elementary/ Secondary Teachers 20

Challenger Center for Space Science Education 3

Chautauqua Short Course— How We Study the Earth and Oceans from Space 28

Chesapeake Bay from Space 61

Chesapeake Bay Watershed Initiative 3

Climate Change Presentation Kit, 1999 69

CloudSAT 38, 78–79

CORE 83

Curriculum Improvement Partnership Award Program (CIPA) 10–11, 41

Curriculum Support and Dissemination 31–43

Elementary & Secondary . . . 31–41

Postsecondary 41–43

DAACs: *see Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAAC)*

DAAC's Supporting Earth Observing Science Yearbook 73

Data Discovery: El Niño 66, 69

Data Discovery: Ozone 66, 70

Data Discovery: The Amazon 65–66, 69

DataSlate 66, 70

Destination Earth: the Official Web Site for NASA's Earth Science Enterprise 80

Discover Earth Classroom Materials 66, 70

Dr. Art's Guide to Planet Earth 66

The Dynamic Earth 4, 20–21, 31-32, 56

Earth & Sky 63, 66, 70, 75

Earth & Sky Broadcast Fellowship 57

Earth from Above: Using Color-Coded Satellite Images to Examine the Global Environment 73

Earth Observatory 75, 80

Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAAC) 80–81

Alaska SAR Facility 81

Earth Resources Observation System (EROS) Data Center (EDC) Land Processes DAAC 81

Goddard Space Flight Center (GSFC) DAAC 81

Langley Research Center (LARC) DAAC 81

National Snow and Ice Data Center (NSIDC) 81

Oak Ridge National Laboratory (ORNL) DAAC 81

Physical Oceanography Distributed Active Archive Center (DAAC) 81

Socio-Economic Data and Applications Center (SEDAC) 81

Affiliated Data Centers:

Global Hydrology and Climate Center 81

National Oceanic and Atmospheric Administration Satellite Active Archive (NOAA-SAA) 81

Earth Science Component for Academic Professional Enhancement (ESCAPE) 21, 44
Earth Science Education Products and Resources 63–81
Earth Science Enterprise Education Update 79
Earth Science Enterprise Museum Support 57
Earth Science Enterprise Research Program—University of Montana 21, 44
Earth System Science Academy 21–22
Earth System Science Education Alliance (ESSEA) 22–23, 32-33, 45–46
Earth System Science Fellowship Program 11
Earth System Science Online Course: An Opportunity in Geography Education 23
Earth System Science Online Professional Development Courses 22-23, 32–33, 45–46
Elementary Teachers 22, 32, 45, 73
High School Teachers 22-23, 32–33, 45–46, 73
Middle School Teachers 22, 32, 45, 73
Earth SystemsConnections: An Integrated K–5 Science, Mathematics, and Technology Curriculum 33
Earth Update 63–64, 66, 70, 75
EarthKAM: *see ISS EarthKAM*
Ecosystem Change and Public Health Textbook 73
Educational Technology 44–51
Elementary and Secondary 44–50
Postsecondary 50–51
Educator Resource Center Network (ERCN) 82
Electronic Theater Presentations . . 57
Enhancement of the Global Systems Science High School Curriculum for the Digital Earth Initiative 33–34, 46
Environmental Education Initiative—Field Museum of Chicago 34, 57–58
EO-1 . . . . . 37, 77
EOS Project Science Office 81
EOS Science Plan, 1999 73–74
EOSDIS: *see Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAAC)*
EROS Data Center DAAC 81
ESSE: *see University Based Program in Earth System Science Education (ESSE)*
ESSEA: *see Earth System Science Education Alliance*
Event Based Science (EBS) 34
Event-Based Science (EBS): Remote-Sensing Activities 34–35, 67
Everyday Classroom Tools 64
Exploring Earth from Space (LS-1999-05-001-HQ) . . . 64, 67, 70
Exploring the Environment 64, 67, 70
Exploring Wetlands with Satellite Sensing and Exploring Remote Sensing: A Hands-on Experience . . . 67
Eyes on Earth 58
First Image of the Global Biosphere (Hql-325) 76
Forces of Change 58
Forest Watch 4
From a Distance: An Introduction to Remote Sensing/GIS/GPS 64, 67, 70
From the Top of the World to the Bottom of the Food Web 79
The Gaia Crossroads Project 23–24, 46–47
Geomorphology from Space, 1986 . . . . . 71, 74
GESSEP: *see NASA Goddard Space Flight Center Earth System Science Education Program (GESSEP)*
GIFTS 38, 79
Girl Scouts of the USA: *see Reach for the Stars*
GISS: *see NASA Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)*
Glacier Bay, Alaska, From the Ground, Air and Space, 1996 80
Glacier Power 64
Global Hydrology and Climate Center 81
Global Links 58–59
Global Systems Science (GSS) 71
The GLOBE Program . . 4–5, 64, 67, 71
Goddard Space Flight Center (GSFC) DAAC 81
Goddard Space Flight Center/ Howard University Fellowship in Atmospheric Science (GoHFAS) 11
GRACE 37, 78
Graduate Student Summer Program in Earth System Science 12
GSRP: *see NASA Graduate Student Researchers Program*
ICESat 37, 78
Informal Education 56–60
Interactions and Diversity: Earth System Science and Beyond 24
An Interdisciplinary Professional Development Program for Teachers on Earth System Science Using Information Technology 24–25
Into the Arctic: Information and Education Activities for Studying Climate 71
ISS EarthKAM 5, 25, 47
The JASON Project 5, 47
Jason-1 . . . . . 37, 77–78
Jason: An Ocean Odyssey Video, 2001 80

BEST COPY AVAILABLE

The Journal of Earth System Science Education (JESSE) 41–42, 50
Landsat 7 . . . . . 37, 77
Langley Research Center (LARC) DAAC 81
Learning Technologies Project 35, 47–48
Lithographs 76
Maryland Earth and Space Systems Science Curriculum Project 35, 52
Mathematics of the Great Dismal Swamp 35–36
Measurements of Pollution in the Troposphere (MOPITT) Brochure 74
METEOR 3M-1/SAGE III 37, 78
Metropolitan East Coast (MEC) Assessment Educators Pack 67
Minority University-SPace Interdisciplinary Network (MU-SPIN) 36, 42, 48, 50
Mission Geography 64, 67–68, 71
Museums: *see also Earth Science Enterprise Museum Support*
Museums Teaching Planet Earth . . 59
NASA Academy 12
NASA Connect: Data Analysis, and Measurement—Ahead, Above the Clouds 80
NASA Earth Science Education Products Workshops 53
NASA Earth Science Enterprise Science Writing and Mulitmedia Team 76
NASA Earth Science Missions—Education 36–38, 76–79
NASA Facts 79
NASA Faculty Fellowship Program 28
NASA Field Center Educator Resource Centers 82–83
NASA Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP) . . 6, 13, 25–26, 28–29, 38–39
NASA Goddard Space Flight Center Earth System Science Education Program (GESSEP) 39
NASA Graduate Student Researchers Program (GSRP) 13
NASA–National Park Service Partnership 59
NASA Resources for Educators 82–83
NASA Space Grant Extension Specialist in Geospatial Technology 61–62
NASA Spacelink 83
NASA Student Involvement Program (NSIP) 6
NASA Summer School for High Performance Computational Earth and Space Sciences . . . 13–14
NASA Television 83
NASA Undergraduate Student Research Program (USRP) 14
NASA Workforce/Professional Development Program 61
NASA's Earth Observing System: Global Change Media Directory 75
NASA's Earth Observing System: Terra Spacecraft 76
NASA's Education Home Page 83
National Oceanic and Atmospheric Administration Satellite Active Archive (NOAA-SAA) 81
National Research Council (NRC) Resident Research Associateship (RRA) Programs 18
National Snow and Ice Data Center (NSIDC) 81
National Space Grant College and Fellowship Program (NSGCFP) 14, 83
Newsletter: *see Earth Science Enterprise Education Update*
NOVA 29, 42–43, 54–55
NSIP: *see NASA Student Involvement Program*
Oak Ridge National Laboratory (ORNL) DAAC 81
Odyssey of the Mind 6–7
Our Mission to Planet Earth: A Guide to Teaching Earth System Science, 1994 64
PACES Scholars 15
Partnership Awards for the Integration of Research into Undergraduate Education (PAIR) 15
Physical Oceanography Distributed Active Archive Center (DAAC) 81
The Pigeon Adventure: An Adventure through Remote-Sensing History 39
PIPELINES . . . 7, 15–16, 26, 29–30, 53
Planet Earth Science—Earth System Science Education Courseware 39–40
Posters 79
The Potential Consequences of Climate Variability and Change 65, 68, 71
Project SUN—Students Understanding Nature 7–8, 48–49
PUMAS (Practical Uses of Math and Science) 40, 81
QuikScat/SeaWinds 37, 77
Reach for the Stars: Girl Scouts of the USA, Science and NASA 59–60
Regional Earth Science Applications Centers (RESACs) 40–41, 53–54, 62
Remote Sensing Core Curriculum . . 74
Remote Sensing of Tribal Lands 16, 43
The Remote Sensing Tutorial 74
Rise and Fall of the '97–'98 El Niño as tracked by the TOPEX/POSEIDON 79
SeaWiFS Poster with Teaching Supplement 79
Scenario Based Learning: Inquiry for a Digital Earth 50

Science Writers Guide to Landsat-7 75
Science Writers Guide to Terra 75
SeaWiFS 36, 77
SeaWinds on ADEOS II 38, 78
SkyMath: Mathematics for a Blue Planet 68
Socio-Economic Data and Applications Center (SEDAC) . . . 81
SORCE 38, 78
Spacelink: *see NASA Spacelink*
Space Place 75
STEP Careers in Research Exploration Program 16–17
Students' Cloud Observations Online S'COOL) 8, 26–27, 65, 68, 71
Student Support 2–18
Elementary–Secondary 2–9
Undergraduate–Graduate . . . 10–18
Postdoctorate 18
Student's Online Atmospheric Research (SOLAR) 8–9, 49
Studying Earth's Environment from Space 72, 74
Summer Institute on Atmospheric and Hydrospheric Sciences 17
SunSplash, 1997 80
Support for Systemic Improvement 52–55
Elementary and Secondary . 52–54
Undergraduate 54–55
teachearth.com 65, 68, 72
Teacher/Faculty Preparation and Enhancement 19–30
Elementary–Secondary 19–27
Postsecondary 28–30
Terra 37, 77
The Translingual Earth System Science Education Center 41
The Tropical Center for Space and Earth Studies (TCESS) . . 27, 54
TOPEX/Poseidon 36, 77
Tropical Rainfall Measuring Mission (TRMM) 37, 77
UARS—The Upper Atmosphere Research Satellite Video and Resource Guide 80
Undergraduate Student Awards for Research (USAR) 17
Understanding Our Changing Planet (HqL-430) 76
Understanding the Biosphere from the Top Down 65, 68, 72
University Based Program in Earth System Science Education (ESSE) 43, 55
University of Montana's Earth Observing System (EOS) Education Project . . . 27, 41, 49–50
USRP: *see NASA Undergraduate Student Research Program*
Videotapes 79–80
Virtual Vacationland 65, 68, 72
Visible Earth 75
Visit to an Ocean Planet 68, 72
Visiting Student Enrichment Program 9, 17–18
Water is a Force of Change (Hql-401) 76
Windows to the Universe 65, 69, 72, 76
Workforce/Professional Development 61–62
World Cloud Cover Pattern (HqL-326) 76
World Watcher: Global Warming Project 69, 72, 74
Web Sites 80–81
You Be the Scientist with Satellite Imagery in EZ/EC Communities 9

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MODIS Global Sea Surface Temperature. Every day the Moderate-resolution Imaging Spectroradiometer (MODIS) measures sea surface temperature over the entire globe with high accuracy. This false-color image shows a one-month composite for May 2001. Red and yellow indicates warmer temperatures, green is an intermediate value, while blues and then purples are progressively colder values. The new MODIS sea surface temperature product will be particularly useful in studies of temperature anomalies, such as El Niño, as well as research into how air-sea interactions drive changes in weather and climate patterns. MODIS was launched in December 1999 aboard NASA's Terra satellite. Visit **http://terra.nasa.gov** to learn more about MODIS and Terra. **CREDIT:** Image courtesy MODIS Ocean Group, NASA GSFC, and the University of Miami.

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Iceberg B-15, Ross Ice Shelf, Antarctica. **CREDIT:** Jacques Descloitres, MODIS Land Science Team.

Salish Kootenai College research interns Shawn Lahr and Lee Calf Looking using a GPS receiver to study an aspen stand on the Flathead Indian Reservation. **CREDIT:** Photo by Rick Borst *(photo also appears on title page and page 1).*

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Teacher from the Little Wound School on the Pine Ridge Lakota Sioux reservation working with the Earth Systems Connections curriculum. **CREDIT:** Photo courtesy of Lee Vierling, South Dakota School of Mines & Technology.

Page 2
Elizabeth City State University (ECSU) student program participants. **CREDIT:** Photo courtesy of Linda Hayden, ECSU.

Page 31
ECSU student program participants. **CREDIT:** Photo courtesy of Linda Hayden, ECSU.

Page 44
From The Global System Science Student Book, *New World View.* **CREDIT:** Photo by Cary Sneider.

Page 52
Climate Change Workshop sponsored by NASA and the National Science Foundation, December 2001, Fairbanks Alaska. **CREDIT:** Photo courtesy of Elena Sparrow, University of Alaska, Fairbanks.

Page 56
Girl Scouts exhibiting their Earth system science project on Earth Day at the VA Air and Space Center. **CREDIT:** Photo by Joel S. Levine, NASA Langley Research Center.

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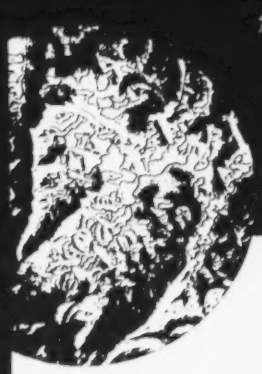
Page 82
Student Argonauts and Dr. Robert Ballard of the JASON Project prepare for a broadcast from NASA in Houston. **CREDIT:** Photo courtesy of the Jason Project.

96



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Space
Administration

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97

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